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Motor Vehicle Emission Inspection/Maintenance Information Ki

(U.S.) Environmental Protection Agency
Ann Arbor, MI

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MOTOR VEHICLE EMISSION INSPECTION/MAINTENANCE INFORMATION KIT

Inspection and Maintenance Staff
Emission Control Technology Division
Office of Mobile Source Air Pollution Control
Office of Air, Noise, and Pollution
U.S. Environmental Protection Agency

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16. ABSTRACT

Transportation-related air pollution continues to poison the air we breathe. In the nation's urban areas almost all of the carbon monoxide, about half of the hydrocarbons, and somewhat less than half of the nitrogen oxides (the latter two helping to form photochemical oxidants or smog) come from mobile sources.

Inspection/maintenance complements the national effort to control motor vehicle emissions. The Clean Air Act Amendments of 1977 set forth specific requirements for the implementation of motor vehicle inspection/maintenance (I/M) programs.

This report contains a policy paper indicating what the Environmental Protection Agency will consider a minimally acceptable program wherever I/M is required by the Act. Also included are sections detailing the benefits, costs, legislation, training and implementation of I/M programs.

17. KEY WORDS AND DOCUMENT ANALYSIS

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MOTOR VEHICLE EMISSIONS INSPECTION/MAINTENANCE INFORMATION KIT

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Inspection/Maintenance - A Summary

Transportation - related air pollution continues to poison the air we breathe. In the nation's urban areas almost all of the carbon monoxide, about half of the hydrocarbons, and somewhat less than half of the nitrogen oxides (the latter two helping to form photochemical oxidants or smog) come from mobile sources.

I/M complements the national effort to control motor vehicle emissions. In the 1970 Amendments to the Clean Air Act, Congress mandated that new cars* in 1975 had to cut emissions by 90% compared to then current levels. Though the final compliance date has been delayed to 1981, a significant tightening of the applicable standards went into effect in 1975 and another is planned in 1980. These standards are intended to cut the adverse health impacts of transportation-related pollution. The two main pollutants of concern are photochemical oxidants and carbon monoxide.

Health Effects of Transportation-Related Pollutants

Photochemical oxidants are formed by a complex series of chemical reactions initiated when hydrocarbons and nitrogen oxide emissions from autos are exposed to sunlight (resulting in photochemical smog). They cause irritation of the eyes and mucous membranes and aggravate existing respiratory illness. The elderly and very young are particularly affected. Ozone is the main constituent of photochemical smog.

* Other motor vehicles have since also had standards prescribed.

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Carbon monoxide (CO), a colorless, odorless, tasteless gas, is formed as a result of incomplete combustion. Carbon monoxide, inhaled into the lungs, enters the bloodstream and readily combines with hemoglobin, the substance which carries oxygen to the cells. Oxygen is thus inhibited from being distributed throughout the body, causing dizziness and headaches. CO can weaken the functioning of the heart, impair motor ability, and slow response times. It is of special concern to those with heart disease.

State Implementation Plans: Structure and History

In the Clean Air Act, Congress required the U.S, Environmental Protection Agency (USEPA) to review health-related data to provide the basis for National Ambient Air Quality Standards (NAAQS). Each State was required to have a State Implementation Plan (SIP) for the control of each designated pollutant down to the NAAQS. Some States submitted adequate SIPs for the control of oxidants and CO, but USEPA had to promulgate SIPs in some areas where States either submitted an inadequate SIP or no SIP for oxidants and/or CO.

The NAAQS however were not generally attained and maintained as the original plans provided. Reasonable measures such as I/M were not implemented, deterioration of new cars' emissions was greater than originally projected, and the oxidant problem was more pervasive than it was originally thought to be.

The Requirements of the Clean Air Act Amendments of 1977

With the understanding that the problem of transportation-related pollutants would have to be attacked more comprehensively than in the past, Congress enacted the Clean Air Act Amendments in August 1977. Congress mandated that all areas with violations of the NAAQS be designated as non-attainment areas. 104 metropolitan areas were designated in February 1978 including 103 areas for oxidants, 62 for CO, and 6 for NO_2. Congress further required States responsible for these areas to produce revisions to their State Implementation Plans (SIPs) by January 1, 1979. These provisions must provide for attainment and maintenance of the NAAQS as soon as possible but no later than December 31, 1982. For oxidants and CO, if it is demonstrated by a State to EPA that attainment cannot be achieved by 1982, even with the implementation of all reasonably available measures, then a specific schedule for the implementation of I/M is required to be submitted with the 1979 plan revisions and an extension of the attainment date to no later than December 31, 1987, may be granted.

I/M as Part of a Comprehensive Control Effort

The Federal Motor Vehicle Control Program (FMVCP) is designed to ensure the production of vehicles which, with proper maintenance and use, will meet applicable emission standards throughout their useful lives.

The FMVCP consists of: 1. certification of prototypes to insure that new vehicle standards are met; 2. random testing of production vehicles at the assembly line; and 3. recall of vehicles when a model line is found to have a significant emission-related defect in use. I/M complements this effort by providing a means to assure that reasonable maintenance occurs on all affected vehicles.

Where the air quality standards are exceeded, overall emissions must be reduced so that the standards will be met. The FMVCP, stationary source controls (for hydrocarbons), and I/M all provide help in reaching the NAAQS. Transportation-related measures, such as exclusive bus lanes, carpooling, and improved mass transit can also be included in SIPs to reach necessary emission reductions.

The Benefits and Costs of an I/M Program

An automobile inspection and maintenance program is a practical, effective and cost-effective strategy.

Practicality:

The implementability of I/M has been demonstrated in several different areas already. New Jersey, for instance, started their program in 1972 and initiated mandatory I/M in 1974. There are now ten I/M programs in existence, six of which are mandatory in some form. Other areas have initiated introductory programs and several additional States have passed legislation.

Benefits:

USEPA estimates that a properly operated I/M program can produce a 20 to 30% reduction or more* after several years of program implementation. New Jersey, Arizona, and Oregon have all reported significant idle emission reductions. In combination with the FMVCP, I/M helped to produce a reduction of 26% in 3 1/2 years in ambient CO concentrations on a statewide basis in New Jersey.

Costs:

Costs to date have been reasonable. Inspection fees alone generally support the program. Failure rates have ranged from 12-36% and average repair costs have ranged from $16 to $32. The most current averages in New Jersey, Oregon, and Arizona are $15.86, $18.86, and $23.02, respectively. The median cost of repairs has ranged from $8 to $20.

Types of I/M

There are three basic structures for I/M programs: centralized (state or municipally owned and operated), centralized (contractor owned and operated), and decentralized, private garage-based inspection and

* Compared to what emissions would have been without I/M.

maintenance facilities. Depending upon an area's existing administrative structure, the costs involved, the presence of existing safety inspection facilities, the geographic location, and several other factors, one of the above systems will generally be employed.

Additional considerations include the type of inspection made or emission test to be employed; the nature and degree of service industry involvement and training; the necessary surveillance and auditing; and the realistic I/M emission standards or "cutpoints" used to determine whether or not a vehicle passes the test. The "cutpoints" will determine the stringency of the program which determines the achievable emission reduction.

The Need for Enabling Legislation

To implement an I/M program, there is a need for adequate legal authority; this can often mean that state (sometimes local) legislation is required. If I/M is needed for an extension of the air quality standard attainment date, USEPA requires a certification of adequate legal authority by June 30, 1979. In unusual cases, this deadline may be extended to July 1, 1980, but only if either a) the legislature has had no opportunity to consider legislation between the enactment of the 1977 Amendments to the Act and June 30, 1979, and/or b) there has not been enough time to complete necessary technical studies.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ANN ARBOR, MICHIGAN 48105

JUL 17 1978

OFFICE OF
AIR AND WATER PROGRAMS

SUBJECT: Inspection/Maintenance Policy

FROM: David G. Hawkins, Assistant Administrator
for Air and Waste Management

MEMO TO: Regional Administrators, Regions I - X

As you know, the Clean Air Act Amendments of 1977 set forth specific requirements for the implementation of motor vehicle inspection/maintenance (I/M) programs. Attached is a policy paper indicating what EPA will consider a minimally acceptable program wherever I/M is required by the Act. It should aid your efforts to provide for adequate I/M submissions for the State Implementation Plan (SIP) revisions of January 1, 1979. Please continue to contact me if problems in I/M implementation develop.

cc: Air and Hazardous Materials Division
Directors, Regions I, III - X
Environmental Programs Division Director,
Region II
Air Programs Branch Chiefs, Regions I - X

Policy for the Development and Implementation of Inspection/Maintenance Programs

The Clean Air Act Amendments of 1977 provide new direction for the development and implementation of motor vehicle inspection/maintenance (I/M) programs. If states are not able to demonstrate attainment of the standards for oxidant (Ox) or carbon monoxide (CO) by December 31, 1982, a specific schedule for the implementation of I/M must be included in the State Implementation Plan (SIP) revisions of January 1, 1979 for the plan to meet the requirements of Section 172. The general requirements for the I/M programs are set out in a February 24, 1978 memorandum from the EPA Administrator to the Regional Administrators (reprinted in the Federal Register on May 19, 1978, 43 F.R. 21673). The requirements, for these programs, are explained in more detail below.

A. I/M SIP Revision Development and the January 1, 1979, Submittal

In producing an I/M SIP revision, the states should provide for:

1. an analysis of the benefits and costs of the program;
2. a public information effort;
3. a legislative proposal; and
4. a schedule for I/M implementation.

A copy of suggested steps for development of the SIP revision is attached (Attachment 1). Before the January 1, 1979 submittal, the SIP revision must be adopted by the state air pollution control board or agency head as appropriate. As a part of the SIP revision submittal itself, there must be a commitment by the Governor to implement the I/M program according to the schedule submitted.*

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*Sections 172(b)(7) and (10) provide that the plan revisions required for nonattainment areas shall —

(7) identify and commit the financial and manpower resources necessary to carry out the plan provisions required by this subsection; [Emphasis added]

and shall —

(10) include written evidence that the state, the general purpose local government or governments, or a regional agency designated by general purpose local governments for such purpose, have adopted by statute, regulation, ordinance, or other legally enforceable document, the necessary requirements and schedule and timetables for compliance, and are committed to implement and enforce the appropriate elements of the plan; [Emphasis added]

These plan elements should be prepared in accordance with the guidance on pages 186-188 of the Compilation of Presentations prepared by EPA's Office of Air Quality Planning and Standards (OAQPS) for the "Workshops on Requirements for Nonattainment Area Plans" February -March 1978 (pages 218-220 in the April 1978 edition).

B. The I/M Implementation Schedule

The specific items listed below must be included as a part of the States' I/M implementation schedules with specified dates for implementation of each item. The stringency planned for the program and other factors affecting the potential for emission reductions should also be indicated. Additional items if necessary because of local factors may be required by USEPA Regional Offices.

1. Initiation (or continuation) of public information program including publicizing the I/M program in the media, meeting and speaking with affected interest groups, etc.

2. Preparation of a draft legislative package and submittal of legislation package to legislature if additional legislative authority is needed.

3. Certification of adequate legal authority by appropriate state official.

4. Initial notification of garages explaining program and schedule of implementation.*

5. Development and issuance of RFPs.*

6. Award to contractor(s).*

7. Initiation of construction of facilities.*

8. Completion of construction of facilities.*

9. Adoption of procedures and guidelines for testing and quality control including emission analyzer requirements (and licensing requirements for private garages, if applicable*).

10. Notification of and explanation to garages of actions in step 9.*

11. Completion of equipment purchase and delivery of equipment.

12. Development and adoption of cutpoints.

13. Initiation of hiring and training of inspectors or licensing of garages.*

14. Initiation of introductory program (voluntary maintenance with either voluntary or mandatory inspection) if not previously initiated.

15. Initiation of mechanics training and/or information program.

16. Initiation of mandatory inspection.

17. Initiation of mandatory repair for failed vehicles.

If certification of adequate legal authority occurs after January 1979, the States may modify previous commitments to implement and enforce the elements of the schedule to conform to the legal authority.** These modifications will be approved by the EPA Regional Offices and must be consistent with the Administrator's February 24, 1978, policy memorandum. The documents should be submitted to the EPA Regional Offices for inclusion in the SIP revisions already submitted by January 1, 1979. Any necessary adjustments to the schedule may be made at this time but must be approved by the EPA Regional Offices.

C. Authority to Implement I/M

Normally, adequate legal authority to implement a SIP revision must exist for a revision to be approved. Where a legislature has had adequate opportunity to adopt enabling legislation before January 1, 1979, the Regional Administrator should require certification that adequate legal authority exists for I/M implementation by January 1, 1979. However, for many states there will be insufficient opportunity to obtain adequate legal authority before their legislatures meet in early 1979. Therefore, a certification of legal authority for the implementation of I/M in these states must be made no later than June 30, 1979. An extension to July 1, 1980, is possible, but only when the state can demonstrate that (a) there was insufficient opportunity to conduct necessary technical analyses and/or (b) the legislature has had no opportunity to consider any necessary enabling legislation for inspection/ maintenance between enactment of the 1977 Amendments to the Act and June 30, 1979. Certification of adequate legal authority, or other evidence that legal authority has been adopted, must be submitted to the EPA Regional Offices to be included in the SIP revision already submitted. Failure to submit evidence of legal authority by the appropriate deadline will constitute a failure to submit an essential element of the SIP, under Sections 110(a)(2)(I) and 176(a) of the Act.

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*Dependent on type of system chosen (state-run centralized, contractor centralized, or decentralized).

**See footnote on page 1.

Prior to the respective deadlines for initiating mandatory inspection and mandatory repair of failed vehicles, the state, local government, or regional agency should adopt whatever legally enforceable requirements are necessary to ensure that vehicles are not used unless they comply with the inspection/maintenance requirements. Written evidence of adoption of these requirements should be submitted to the EPA Regional Offices, to be included in the SIP revision already submitted by January 1, 1979.*

D. I/M Implementation Deadlines

Implementation of I/M "as expeditiously as practicable" shall be defined as implementation of mandatory repair for failed vehicles no later than two and a half years after passage of needed legislation or certification of adequate legal authority for new centralized systems and one and a half years after legislation or certification for decentralized systems or for centralized systems which are adding emission inspections to safety inspections. For the normal legislation deadline of June 30, 1979, new centralized programs must start by December 31, 1981, and all others must start by December 31, 1980. For the case of the latest possible legislation date, July 1, 1980, this means that a new centralized program must start by December 31, 1982, while all other programs must start by December 31, 1981. Where I/M can be implemented more expeditiously, it must be. Each state implementation schedule must be looked at individually to determine if it is as expeditious as practicable. Implementation dates ordered by courts, if earlier than these dates, take precedence.

E. Geographic Coverage

I/M should focus on metropolitan areas and should include the entire urbanized area and adjacent fringe areas of development. Boundaries of the area affected may be adjusted if an equivalent emission reduction is achieved. For urbanized areas of 200,000 population or greater which need I/M to obtain an extension of the 1982 attainment date, full mandatory I/M must be implemented by the deadlines indicated above. Statewide programs are encouraged, especially for those states which are small and highly urbanized.

It should be emphasized that all nonattainment areas must have SIPs which are adequate to attain and maintain the National Ambient Air Quality Standards (NAAQS) by 1982 or by no later than 1987 should an acceptable nonattainment demonstration be made. For areas under 200,000, EPA will not at this time automatically require I/M schedules in 1979 as a condition for SIP approval or an extension. However, areas under 200,000 still have to attain and maintain NAAQS as expeditiously as practicable, and I/M is encouraged as a means of helping to provide for an adequate SIP. EPA will review the need for I/M in areas under 200,000 after the 1979 SIP revisions are submitted, and will consider additional requirements at that time.

*See footnote on page 1.

F. Emission Reductions Required for I/M

I/M programs must produce at least a 25 percent reduction in light duty vehicle (LDV) exhaust emissions of hydrocarbons and a 25 percent reduction in LDV emissions of carbon monoxide by December 31, 1987, compared to what emissions would be without I/M on the basis of the most recent motor vehicle emission factors. However, the choices of stringency factor to be used and other actions affecting the potential for emission reduction should be made by the states. States should of course be encouraged to develop programs which produce more emission reduction when possible. The final revision to Appendix N (40 C.F.R., Part 51) when promulgated (along with its minimum program requirements) should be used to determine if the program described in the implementation schedule will meet the minimum 25 percent CO/25 percent HC criterion. Should a program not need to be this stringent to attain and maintain the NAAQS by 1982, the I/M program need be only as stringent as needed to assure conformity with NAAQS. Should a state want to emphasize control of one particular pollutant at the expense of the other, the plan for such an I/M program must be submitted to the appropriate EPA Regional Office for approval.

G. Minimum Program Requirements

In addition to the emission reduction requirement above, all I/M programs must:

1. provide for regular periodic inspections of all vehicles for which emission reductions are claimed;*

2. provide for maintenance and retesting of failed vehicles to provide for compliance with applicable emission standards;

3. prohibit registration or provide some equally effective mechanism to prevent vehicles which do not comply with the applicable exhaust emission requirements from operating on public roads;

4. provide for quality control regulations and procedures for the inspection system including:

*Random roadside checks, while a useful addition to an I/M program, are not an acceptable substitute for regular periodic inspections.

a. minimum specifications for emission analyzers

b. required calibrations of all types on analyzers and

c. minimum record keeping;

5. provide for either a mechanics training program or a program to inform the public of service establishments with approved emission analyzers; and

6. inform the public of the reason for the I/M program plus the locations and hours of inspection stations.

Decentralized systems must also comply with the following requirements.

1. All official inspection facilities must be licensed. Provisions for the licensing of inspection facilities must insure that the facility has obtained, prior to licensing, analytical instrumentation which has been approved for use by the appropriate state, local, or regional government agency. A representative of the facility must have received instructions in the proper use of the instruments and in vehicle testing methods and must have demonstrated proficiency in these methods. The facility must agree to maintain records and to submit to inspection of the facility. The appropriate government agency must have provisions for penalties for facilities which fail to follow prescribed procedures and for misconduct.

2. Records required to be maintained should include the description (make, year, license number, etc.) of each vehicle inspected, and its emissions test results. Records must also be maintained on the calibration of testing equipment.

3. Summaries of these inspection records should be submitted on a periodic basis to the governing agency for auditing.

4. The governing agency should inspect each facility periodically to check the facilities' records, check the calibration of the testing equipment and observe that proper test procedures are followed.

5. The governing agency should have an effective program of unannounced/unscheduled inspections both as a routine measure and as a complaint investigation measure. It is also recommended that such inspections be used to check the correlation of instrument readings among inspection facilities.

6. The governing agency should operate a "referee" station where vehicle owners may obtain a valid test to compare to a test from a licensed station. At least one "referee" station must be present in each I/M metropolitan area.

Attachment 1
Suggested I/M Milestones

1. Complete plan for preparing and implementing I/M SIP revision including:

   a. technical analysis

   b. public information program

   c. development of necessary legislation

   d. development of I/M implementation schedule.

2. Complete technical analysis including:

   a. emission reduction benefits

   b. fuel economy benefits

   c. costs.

3. Complete elements of a continuing public information program including:

   a. further publicity concerning oxidant (and/or carbon monoxide) episodes

   b. meeting with and speaking to affected interest groups (including the public and public officials)

   c. news releases.

4. Complete development of legislative proposals.

5. Complete development of I/M implementation schedule.

6. Receive approval of I/M, including implementation schedule, from air pollution control board or agency head as applicable and introduce into state legislature.

7. Submit SIP revision for I/M, including implementation schedule, to EPA (due no later than January 1, 1979).

8. Obtain legal authority needed to implement I/M (required by July 1, 1979, with some exceptions allowed until July 1, 1980).

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Summary of Emission Reduction Benefits of Inspection/Maintenance

Fleetwide emission reductions can be estimated for motor vehicle inspection/maintenance(I/M) by applying credits that are specific to the type of emission control technology associated with a particular model year, the years a vehicle has been in an inspection/maintenance program, and the stringency of the program involved. USEPA has developed credits for an annual I/M program which are percentage reductions from what emissions would have been without I/M. These credits are listed in Tables 1a through 4d in Attachment 1. Attachment 2 illustrates the application of these credits through several sample calculations.

Assuming nationwide average model year mix and average distribution of vehicle miles traveled by model year, USEPA has also estimated basic emission reductions in 1987 for various types of annual I/M programs. These are tabulated in the Summary Table on the next page. As is indicated in the table, additional credits can be granted for mechanics training activities. The "with mechanics training" credits are the maximum emission reduction credits allowable for I/M programs, but any credits beyond the basic credits must be specifically approved by USEPA.

The credits presented should be used with the emission factors published in March 1978 by USEPA in Mobile Source Emission Factors, Final Document (EPA-400/9-78-005). The credits themselves are also a part of MOBILE1

Summary Table

Light Duty Vehicle Exhaust Emission Reductions from Inspection/Maintenance Programs as of December 31, 1987

Stringency Factor	Starting Date +	Basic Program		With Mechanics Training**	
		CO (%)	HC (%)	CO (%)	HC (%)
10	7/1/80	22.7	26.0	46.8	42.5
	7/1/81	21.5	24.7	46.0	42.3
	7/1/82	19.6	22.6	43.2	39.0
	12/31/82	18.3	20.8	41.6	37.3
20	7/1/80	29.3	30.4	54.2	49.0
	7/1/81	27.9	28.7	52.0	47.2
	7/1/82	25.9	25.7	50.2	45.3
	12/31/82	24.5	23.9	48.8	43.6
30	7/1/80	34.0	33.6	57.7	52.1
	7/1/81	32.3	32.6	56.3	50.9
	7/1/82	30.4	30.0	54.5	49.3
	12/31/82	28.6	27.5	53.2	47.6
40	7/1/80	38.2	35.7	61.1	57.7
	7/1/81	36.6	34.2	59.8	54.3
	7/1/82	34.3	31.8	57.9	53.1
	12/31/82	32.8	30.0	56.5	5112
50	7/1/80	41.4	36.8	62.5	57.2
	7/1/81	40.0	35.5	61.1	56.1
	7/1/82	37.9	32.9	59.3	54.3
	12/31/82	35.5	31.0	57.9	52.8

NOTE-Policy guidance regarding the the utilization of I/M credits is due in November 1978.

+Mandatory repair for failed vehicles is initiated on this date.

* Assumptions:
1. All model years are included in the program.
2. Nationwide averages of vehicle mix by model year plus distribution of vehicle miles traveled by model year are assumed.

** Utilization of all of or part of this credit or part of it can only be made with USEPA approval.

mobile source emissions model computer program so that emissions with I/M implemented can be calculated as a part of an overall emission inventory preparation. (See User's Guide to MOBILE1 - Mobile Source Emissions Model, EPA-400/9-78-007, August, 1978.) AP-42 Supplement 5 emission factors should not be utilized with the credits included here.

With respect to emission control technology, the credits have been separated into four main groups: Technologies I, II, III, and IV. Technology I consists of all pre-catalytic vehicles, or those of model year 1974 and before.* Technology II consists of all "first generation" catalytic vehicles, while "improved catalytic" vehicles are denoted by Technology III. All "future technology" vehicles (those designated to meet the 1981 and later statutory standards and those vehicles which are comparable) are denoted by Technology IV. Calculations utilizing these credits should be consistent with the list below.

Non-California

Model Year	Technology
pre-1975	I
1975-1979	II
1980	III
1981 and later	IV

*While some 1975 and later model year vehicles are not catalyst-equipped, all vehicles should be considered as a part of their applicable model year.

California

Model Year	Technology
pre-1975	I
1975-1979	III
1980 and later	IV

The years a vehicle has been in an inspection program also has an important effect on the emission reductions achievable. I/M programs have the potential to reduce emission deterioration rates of vehicle fleets over time. Therefore, the benefits from inspection/maintenance programs are estimated to increase with added years of program operation. This is reflected in the I/M credits included in both Attachment 1 and the Summary Table.

Finally, the stringency of the program involved has an effect on the total possible emission reduction. The stringency factor is related to the proportion of vehicles that would have failed a given set of I/M testing standards, or cutpoints, prior to implementation of an I/M program. Because some vehicle owners may maintain their vehicles in anticipation of an emissions inspection, the failure rate may tend to be somewhat lower than the stringency factor. In estimating the benefits attributable to programs with various stringency factors, USEPA has assumed that it is as important to fail a high Federal Test Procedure (FTP) carbon monoxide (CO) emitter as a high FTP hydrocarbon (HC) emitter.

Attachment 1

Emission Reductions
Attributable to Inspection/
Maintenance Programs

Table 1.a

ESTIMATED PERCENT REDUCTION IN HYDROCARBON EMISSION
BASIC PROGRAM CREDITS

Technology 1

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	3%	4%	7%	8%	8%
Benefit Year 2	6	8	14	15	16
Benefit Year 3	11	13	20	22	23
Benefit Year 4	15	18	28	30	31
Benefit Year 5	19	22	34	36	37
Benefit Year 6	24	28	39	41	42
Benefit Year 7	27	34	43	46	46
Benefit Year 8	31	36	46	49	50
Benefit Year 9	35	40	49	52	53
Benefit Year 10	39	42	52	54	55
Benefit Year 11	41	45	54	56	57
Benefit Year 12	42	46	55	58	59
Benefit Year 13	44	49	57	59	60
Benefit Year 14	46	50	58	61	61
Benefit Year 15	47	51	59	62	62
Benefit Year 16	48	52	60	63	63
Benefit Year 17	49	54	61	64	64
Benefit Year 18	51	56	62	65	65
Benefit Year 19	52%	57%	63%	65%	66%

Table 1.b

ESTIMATED PERCENT REDUCTION IN CARBON MONOXIDE EMISSION
BASIC PROGRAM CREDITS

Technology 1

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	7%	9%	12%	14%	15%
Benefit Year 2	13	17	21	23	25
Benefit Year 3	17	22	27	29	31
Benefit Year 4	22	27	32	35	36
Benefit Year 5	26	31	36	39	41
Benefit Year 6	30	35	40	43	45
Benefit Year 7	32	37	44	47	49
Benefit Year 8	35	40	47	50	52
Benefit Year 9	37	42	49	52	54
Benefit Year 10	40	44	52	55	56
Benefit Year 11	41	46	53	56	58
Benefit Year 12	42	48	55	58	59
Benefit Year 13	44	49	56	59	61
Benefit Year 14	45	51	58	60	62
Benefit Year 15	46	52	59	61	63
Benefit Year 16	47	53	60	62	64
Benefit Year 17	48	54	61	63	65
Benefit Year 18	50	55	62	64	65
Benefit Year 19	50%	56%	62%	65%	66%

Table 1.c

ESTIMATED PERCENT REDUCTION IN HYDROCARBON EMISSION
MAXIMUM PROGRAM CREDITS (WITH MECHANIC TRAINING)

Technology 1

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	6%	9%	12%	13%	14%
Benefit Year 2	13	14	19	24	25
Benefit Year 3	17	19	27	33	35
Benefit Year 4	20	25	35	40	42
Benefit Year 5	25	31	41	46	48
Benefit Year 6	32	36	44	50	53
Benefit Year 7	35	43	51	54	56
Benefit Year 8	40	45	53	57	59
Benefit Year 9	45	50	55	59	62
Benefit Year 10	47	51	57	61	64
Benefit Year 11	49	53	59	63	65
Benefit Year 12	50	54	61	65	66
Benefit Year 13	53	55	61	65	68
Benefit Year 14	53	56	63	66	69
Benefit Year 15	54	58	65	68	70
Benefit Year 16	56	58	65	68	70
Benefit Year 17	57	61	66	69	71
Benefit Year 18	57	63	66	70	72
Benefit Year 19	58%	63%	67%	71%	72%

Table 1.d

ESTIMATED PERCENT REDUCTION IN CARBON MONOXIDE EMISSION
MAXIMUM PROGRAM CREDITS (WITH MECHANIC TRAINING)

Technology 1

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	11%	16%	20%	22%	23%
Benefit Year 2	20	23	29	34	35
Benefit Year 3	26	29	37	41	42
Benefit Year 4	30	35	42	46	48
Benefit Year 5	34	40	47	51	53
Benefit Year 6	40	43	49	55	57
Benefit Year 7	43	49	55	58	60
Benefit Year 8	47	51	57	61	62
Benefit Year 9	50	54	59	63	65
Benefit Year 10	52	55	61	64	66
Benefit Year 11	53	57	62	65	68
Benefit Year 12	55	58	64	67	69
Benefit Year 13	58	59	64	68	70
Benefit Year 14	57	60	66	69	71
Benefit Year 15	58	62	67	70	72
Benefit Year 16	59	62	68	70	72
Benefit Year 17	61	64	68	71	73
Benefit Year 18	60	66	68	72	74
Benefit Year 19	62%	66%	70%	73%	74%

Table 2.a

ESTIMATED PERCENT REDUCTION IN HYDROCARBON EMISSION
BASIC PROGRAM CREDITS

Technology 2

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	4%	6%	10%	12%	13%
Benefit Year 2	6	11	18	20	22
Benefit Year 3	9	16	24	26	28
Benefit Year 4	11	20	28	32	34
Benefit Year 5	16	23	33	37	39
Benefit Year 6	19	27	36	40	43
Benefit Year 7	20	31	40	43	46
Benefit Year 8	23	33	42	46	49
Benefit Year 9	25	36	45	49	51
Benefit Year 10	28	38	47	51	54
Benefit Year 11	29	40	48	52	55
Benefit Year 12	30	41	50	54	57
Benefit Year 13	32	43	51	55	58
Benefit Year 14	33	44	53	56	59
Benefit Year 15	35	45	55	57	61
Benefit Year 16	36	46	55	59	61
Benefit Year 17	36	47	55	59	62
Benefit Year 18	37	48	57	60	63
Benefit Year 19	38%	49%	58%	61%	64%

Table 2.b

ESTIMATED PERCENT REDUCTION IN CARBON MONOXIDE EMISSION
BASIC PROGRAM CREDITS

Technology 2

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	10%	17%	21%	23%	25%
Benefit Year 2	15	25	31	34	36
Benefit Year 3	20	29	36	39	41
Benefit Year 4	23	32	40	43	45
Benefit Year 5	26	36	44	46	49
Benefit Year 6	28	38	47	49	52
Benefit Year 7	31	41	49	52	54
Benefit Year 8	32	42	51	54	56
Benefit Year 9	34	44	53	56	58
Benefit Year 10	35	46	55	57	60
Benefit Year 11	37	47	56	59	61
Benefit Year 12	37	48	57	60	62
Benefit Year 13	38	49	58	61	63
Benefit Year 14	40	50	59	62	64
Benefit Year 15	41	51	60	63	65
Benefit Year 16	41	52	61	63	66
Benefit Year 17	42	52	62	64	67
Benefit Year 18	43	53	62	65	67
Benefit Year 19	44%	54%	63%	65%	68%

Table 2.c

ESTIMATED PERCENT REDUCTION IN HYDROCARBON EMISSION
MAXIMUM PROGRAM CREDITS (WITH MECHANIC TRAINING)

Technology 2

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	9%	13%	14%	15%	16%
Benefit Year 2	13	16	21	24	26
Benefit Year 3	15	20	28	31	33
Benefit Year 4	18	26	33	36	39
Benefit Year 5	22	31	38	41	43
Benefit Year 6	26	34	41	44	47
Benefit Year 7	28	38	45	48	50
Benefit Year 8	31	41	47	50	53
Benefit Year 9	33	43	50	52	55
Benefit Year 10	35	44	52	54	57
Benefit Year 11	37	45	53	56	59
Benefit Year 12	39	47	54	58	60
Benefit Year 13	40	48	56	58	61
Benefit Year 14	42	50	57	60	63
Benefit Year 15	44	52	59	61	64
Benefit Year 16	44	52	60	62	65
Benefit Year 17	44	53	61	63	65
Benefit Year 18	46	54	61	63	66
Benefit Year 19	48%	55%	62%	65%	67%

Table 2.d

ESTIMATED PERCENT REDUCTION IN CARBON MONOXIDE EMISSION
MAXIMUM PROGRAM CREDITS (WITH MECHANIC TRAINING)

Technology 2

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	17%	26%	30%	32%	33%
Benefit Year 2	25	33	41	45	47
Benefit Year 3	27	36	47	50	52
Benefit Year 4	31	41	50	54	56
Benefit Year 5	35	46	54	57	60
Benefit Year 6	38	48	57	60	62
Benefit Year 7	40	51	59	63	65
Benefit Year 8	43	54	61	64	67
Benefit Year 9	44	56	63	65	68
Benefit Year 10	45	57	65	67	69
Benefit Year 11	49	58	65	68	70
Benefit Year 12	50	59	66	69	71
Benefit Year 13	50	60	67	70	72
Benefit Year 14	53	61	68	71	73
Benefit Year 15	54	63	69	72	74
Benefit Year 16	54	63	70	72	74
Benefit Year 17	55	64	71	73	75
Benefit Year 18	56	65	71	73	75
Benefit Year 19	58%	66%	71%	74%	76%

Table 3.a

ESTIMATED PERCENT REDUCTION IN HYDROCARBON EMISSION
BASIC PROGRAM CREDITS

Technology 3

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	4%	4%	4%	5%	5%
Benefit Year 2	11	13	15	17	18
Benefit Year 3	22	25	28	31	32
Benefit Year 4	32	37	40	43	44
Benefit Year 5	42	46	49	51	53
Benefit Year 6	49	53	55	58	59
Benefit Year 7	54	58	60	63	63
Benefit Year 8	58	62	64	66	67
Benefit Year 9	62	65	67	69	70
Benefit Year 10	64	67	69	71	72
Benefit Year 11	66	69	71	73	73
Benefit Year 12	68	71	72	74	75
Benefit Year 13	69	72	74	75	76
Benefit Year 14	71	73	75	76	77
Benefit Year 15	72	74	76	77	78
Benefit Year 16	73	75	77	78	79
Benefit Year 17	74	76	77	79	79
Benefit Year 18	74	77	78	79	80
Benefit Year 19	75%	77%	79%	80%	81%

Table 3.b

ESTIMATED PERCENT REDUCTION IN CARBON MONOXIDE EMISSION
BASIC PROGRAM CREDITS

Technology 3

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	0%	0%	1%	1%	2%
Benefit Year 2	4	5	6	6	7
Benefit Year 3	8	10	13	14	14
Benefit Year 4	14	18	21	22	22
Benefit Year 5	20	23	27	28	29
Benefit Year 6	26	28	33	34	35
Benefit Year 7	30	32	38	39	40
Benefit Year 8	33	37	42	43	44
Benefit Year 9	35	40	45	47	47
Benefit Year 10	39	43	48	49	50
Benefit Year 11	42	45	50	52	52
Benefit Year 12	44	47	52	54	54
Benefit Year 13	45	49	54	55	56
Benefit Year 14	48	51	56	57	58
Benefit Year 15	49	52	57	58	59
Benefit Year 16	50	53	59	60	60
Benefit Year 17	50	54	60	61	61
Benefit Year 18	53	56	61	62	62
Benefit Year 19	55%	57%	62%	63%	63%

Table 3.c

ESTIMATED PERCENT REDUCTION IN HYDROCARBON EMISSION
MAXIMUM PROGRAM CREDITS (WITH MECHANIC TRAINING)

Technology 3

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	10%	13%	15%	16%	16%
Benefit Year 2	33	36	38	39	39
Benefit Year 3	51	53	54	54	54
Benefit Year 4	59	62	64	64	64
Benefit Year 5	67	69	70	70	70
Benefit Year 6	70	73	74	74	74
Benefit Year 7	74	76	77	77	77
Benefit Year 8	76	78	79	80	80
Benefit Year 9	78	80	81	81	81
Benefit Year 10	80	81	82	83	83
Benefit Year 11	80	82	83	84	84
Benefit Year 12	81	83	84	85	85
Benefit Year 13	82	83	85	85	86
Benefit Year 14	83	84	85	86	86
Benefit Year 15	84	85	86	87	87
Benefit Year 16	84	85	86	87	87
Benefit Year 17	85	86	87	87	88
Benefit Year 18	85	86	87	88	88
Benefit Year 19	86%	87%	87%	88%	88%

Table 3.d

ESTIMATED PERCENT REDUCTION IN CARBON MONOXIDE EMISSION
MAXIMUM PROGRAM CREDITS (WITH MECHANIC TRAINING)

Technology 3

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	5%	8%	11%	13%	14%
Benefit Year 2	24	27	29	30	30
Benefit Year 3	40	42	43	43	43
Benefit Year 4	48	51	52	52	52
Benefit Year 5	56	58	59	59	59
Benefit Year 6	60	63	64	64	64
Benefit Year 7	65	66	67	68	68
Benefit Year 8	67	69	70	71	71
Benefit Year 9	69	71	72	73	73
Benefit Year 10	72	73	74	75	75
Benefit Year 11	72	74	75	76	76
Benefit Year 12	74	76	76	77	77
Benefit Year 13	75	76	77	78	78
Benefit Year 14	76	77	78	79	79
Benefit Year 15	77	78	79	80	80
Benefit Year 16	78	79	80	80	81
Benefit Year 17	78	79	80	81	81
Benefit Year 18	79	80	81	82	82
Benefit Year 19	79%	80%	81%	82%	82%

Table 4.a

ESTIMATED PERCENT REDUCTION IN HYDROCARBON EMISSION
BASIC PROGRAM CREDITS

Technology 4

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	3%	3%	3%	3%	3%
Benefit Year 2	7	7	7	8	8
Benefit Year 3	14	15	16	17	17
Benefit Year 4	23	24	25	26	27
Benefit Year 5	31	33	34	35	36
Benefit Year 6	38	40	41	42	43
Benefit Year 7	44	46	47	48	49
Benefit Year 8	49	51	51	52	54
Benefit Year 9	53	54	55	56	57
Benefit Year 10	56	57	58	59	60
Benefit Year 11	58	60	60	61	62
Benefit Year 12	60	62	62	63	64
Benefit Year 13	62	63	64	65	66
Benefit Year 14	63	65	65	66	67
Benefit Year 15	65	66	67	68	68
Benefit Year 16	66	67	68	69	69
Benefit Year 17	67	68	69	70	70
Benefit Year 18	68	69	70	71	71
Benefit Year 19	69%	70%	71%	71%	72%

(3%)

Table 4.b

ESTIMATED PERCENT REDUCTION IN CARBON MONOXIDE EMISSION
BASIC PROGRAM CREDITS

Technology 4

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	0%	0%	1%	2%	3%
Benefit Year 2	2	4	5	8	12
Benefit Year 3	7	11	13	18	23
Benefit Year 4	13	19	21	28	33
Benefit Year 5	19	26	28	36	42
Benefit Year 6	24	32	34	42	48
Benefit Year 7	29	37	40	47	53
Benefit Year 8	33	42	44	52	57
Benefit Year 9	37	45	48	55	60
Benefit Year 10	40	48	51	58	63
Benefit Year 11	43	51	53	60	65
Benefit Year 12	45	53	55	62	66
Benefit Year 13	47	55	57	63	68
Benefit Year 14	49	56	58	65	69
Benefit Year 15	50	58	60	66	70
Benefit Year 16	52	59	61	67	71
Benefit Year 17	53	60	62	68	72
Benefit Year 18	54	62	63	69	73
Benefit Year 19	55%	62%	64%	70%	74%

Table 4.c

ESTIMATED PERCENT REDUCTION IN HYDROCARBON EMISSION
MAXIMUM PROGRAM CREDITS (WITH MECHANIC TRAINING)

Technology 4

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	7%	11%	12%	14%	15%
Benefit Year 2	24	29	32	36	38
Benefit Year 3	36	45	46	52	54
Benefit Year 4	52	56	58	62	64
Benefit Year 5	54	63	65	68	70
Benefit Year 6	65	68	69	73	74
Benefit Year 7	66	70	72	76	77
Benefit Year 8	69	74	75	78	79
Benefit Year 9	72	76	76	80	81
Benefit Year 10	75	76	77	81	83
Benefit Year 11	75	78	80	82	84
Benefit Year 12	75	80	81	83	85
Benefit Year 13	77	80	81	84	85
Benefit Year 14	79	81	82	85	86
Benefit Year 15	79	82	83	85	87
Benefit Year 16	80	82	83	86	87
Benefit Year 17	80	83	84	86	88
Benefit Year 18	81	84	85	87	88
Benefit Year 19	81%	84%	85%	87%	88%

Table 4.d

ESTIMATED PERCENT REDUCTION IN CARBON MONOXIDE EMISSION
MAXIMUM PROGRAM CREDITS (WITH MECHANIC TRAINING)

Technology 4

	Stringency Factor				
	10%	20%	30%	40%	50%
Benefit Year 1	9%	15%	18%	21%	23%
Benefit Year 2	30	37	39	43	44
Benefit Year 3	41	51	52	57	58
Benefit Year 4	56	60	62	66	66
Benefit Year 5	58	66	68	71	72
Benefit Year 6	68	70	71	75	76
Benefit Year 7	68	72	74	78	79
Benefit Year 8	71	76	77	80	81
Benefit Year 9	74	77	78	81	83
Benefit Year 10	77	78	79	83	84
Benefit Year 11	77	80	82	84	85
Benefit Year 12	76	82	82	85	86
Benefit Year 13	79	82	82	85	86
Benefit Year 14	81	82	84	86	87
Benefit Year 15	81	83	84	86	88
Benefit Year 16	81	84	84	87	88
Benefit Year 17	81	84	85	87	88
Benefit Year 18	82	85	86	88	89
Benefit Year 19	83%	85%	86%	88%	89%

Attachment 2

Methodology for Applying
Attachment 1 Credits

The following estimates of fleetwide HC and CO benefit assume that an inspection/maintenance program is implemented on July 1 of calendar year y, and calculated on July 1 of calendar year i. Interpolation may be applied to obtain benefit estimates for programs which begin or are evaluated at times other than July 1. The following information in addition to the Attachment 1 tables of credits is required for the calculations:

1. The calendar year, y, in which an I/M program was (or will be) operational.

2. The fraction of vehicles of model year i-19 through i contributing to the vehicle population on July 1. Vehicles of model years earlier than i-19 should be considered as model year i-19.

3. Average vehicle miles traveled in calendar year i by each model year group of vehicles.

4. July 1 of calendar year i FTP HC and CO emission factors (gm/mi) for each model year group of vehicles, assuming I/M has never been in effect.

The calculation of benefit for a given pollutant (HC or CO) on July 1 of calendar year i is performed as follows:

$$B_i = 100 \left[\sum_{t=i-19}^{i} b_{it} \; e_{it} \; m_{it} \; p_{it} \right] / \left[\sum_{t=i-19}^{i} e_{it} \; m_{it} \; p_{it} \right],$$

where

b_{it} = Attachment 1 credit for vehicles of model year t on July 1 of calendar year i,

e_{it} = emission factor (gm/mi) for vehicles of model year t on July 1 of calendar year i, assuming I/M has never been in effect,

m_{it} = average vehicle miles traveled per year by vehicles of model year t in calendar year i,

p_{it} = fraction of the July 1, calendar year i, vehicle population which is of model year t.

The b_{it} entries can be found in Attachment 1 by identifying the maximum number of inspections that model year t vehicles could have undergone by July 1 of calendar year i. The maximum number of annual inspections which a model year t vehicle could possibly incur defines the benefit year which is applicable to vehicles of that model year. The b_{it} entry in the above expression for B_i is the credit which corresponds to this benefit year. Model year vehicles which could have undergone more than 19 annual inspections should be counted as having undergone 19.

The calculation of the fleetwide July 1 emission factor ef_i with I/M is performed as follows:

$$ef_i = \frac{100-Bi}{100} \sum_{t=i-19}^{i} e_{it} \; m_{it} \; p_{it} \; / \sum_{t=i-19}^{i} m_{it} \; p_{it}$$

If scenario-specific estimates of e_{it}, m_{it}, and p_{it} are unavailable, nationwide estimates can obtained by referring to the Mobile Source Emission Factors, Final Document (EPA 400/9-78-005, March, 1978). The credits given in Attachment 1 are not applicable to emission factors as estimated in AP-42, Supplement 5. Nationwide estimates of m_{it} and p_{it} are provided in Tables 1 and 2 respectively.

Examples of the Calculation of Benefit:

Example 1: The July 1 nationwide mix of vehicles by model year and nationwide estimates of average vehicle miles traveled apply. An I/M program with a 40% stringency factor was implemented in 1973. Determine the percent reduction in emissions for HC and CO on July 1 of CY 1977, assuming that inspections are annual, and that no mechanic training program is in effect.

Solution: The percent reduction, B_{77}, can be calculated from the following formula:

$$B_{77} = 100 \sum_{t=58}^{77} b_{77,t}\, e_{77,t}\, m_{77,t}\, p_{77,t} \Big/ \sum_{t=58}^{77} e_{77,t}\, m_{77,t}\, p_{77,t}.$$

The following tables detail the calculation of the numerator and denominator of B_{77} for both HC and CO.

	t	$b_{77,t}$	$e_{77,t}$	$m_{77,t}$	$p_{77,t}$	Numerator Product	Denominator Product
	1977	0%	1.3	15.9	.075	0.0	1.6
	1976	12	1.6	15.0	.107	0.3	2.6
HC	1975	20	1.9	14.0	.107	0.6	2.9
	1974	22	5.0	13.1	.106	1.5	6.9
	1973	30	5.7	12.2	.100	2.1	7.0
	1972	30	6.3	11.3	.092	2.0	6.6
	1971	30	6.9	10.3	.085	1.8	6.0
	1970	30	7.4	9.4	.077	1.6	5.4
	1969	30	7.9	8.5	.066	1.3	4.4
	1968	30	8.3	7.6	.052	1.0	3.3
	1967	30	11.3	6.7	.039	0.9	3.0
	1966	30	11.7	6.6	.027	0.6	2.1
	1965	30	12.1	6.2	.018	0.4	1.4
	1964	30	12.5	5.9	.014	0.3	1.0
	1963	30	12.8	5.5	.009	0.2	0.6
	1962	30	13.1	5.1	.006	0.1	0.4
	1961	30	13.4	5.0	.005	0.1	0.3
	1960	30	13.7	4.7	.005	0.1	0.3
	1959	30	14.0	4.4	.005	0.1	0.3
	1958	30%	14.2	4.4	.004	0.1	0.3
						15.1	56.4

HC: $B_{77} = \frac{15.1}{56.4} = 27\%$

	t	$b_{77,t}$	$e_{77,t}$	$m_{77,t}$	$p_{77,t}$	Numerator Product	Denominator Product
	1977	0%	20.3	15.9	.075	0.0	24.2
	1976	23	24.1	15.0	.107	8.9	38.7
CO	1975	34	28.2	14.0	.107	14.4	42.2
	1974	29	60.8	13.1	.106	24.5	84.4
	1973	35	68.7	12.2	.100	29.3	83.8
	1972	35	76.0	11.3	.092	27.7	79.0
	1971	35	82.8	10.3	.085	25.4	72.5
	1970	35	89.0	9.4	.077	22.6	64.4
	1969	35	94.7	8.5	.066	18.6	53.1
	1968	35	99.8	7.6	.052	13.8	39.4
	1967	35	104.7	6.7	.039	9.6	27.4
	1966	35	106.7	6.6	.027	6.7	19.0
	1965	35	108.7	6.2	.018	4.3	12.1
	1964	35	110.6	5.9	.014	3.2	9.1
	1963	35	112.4	5.5	.009	2.0	5.6
	1962	35	114.0	5.1	.006	1.2	3.5
	1961	35	115.6	5.0	.005	1.0	2.9
	1960	35	117.1	4.7	.005	1.0	2.8
	1959	35	118.5	4.4	.005	0.9	2.6
	1958	35%	119.9	4.4	.004	0.7	2.1
						215.8	668.8

CO: $B_{77} = \frac{215.8}{668.8} = 32\%$

Example 2: Determine the percent reduction in emissions, B_{77}, for HC and CO under the assumptions of example 1, except assume that a mechanic training program is in effect.

Solution: The method used for example 1 applies. Only the entries of $b_{77,t}$ will change to reflect the additional benefit credited for an adequate mechanic training program. The following tables give the details of the calculations:

	t	$b_{77,t}$	$e_{77,t}$	$m_{77,t}$	$p_{77,t}$	Numerator Product	Denominator Product
	1977	0%	1.3	15.9	.075	0.0	1.6
	1976	15	1.6	15.0	.107	0.4	2.6
HC	1975	24	1.9	14.0	.107	0.7	2.9
	1974	33	5.0	13.1	.106	2.3	6.9
	1973	40	5.7	12.2	.100	2.8	7.0
	1972	40	6.3	11.3	.092	2.6	6.6
	1971	40	6.9	10.3	.085	2.4	6.0
	1970	40	7.4	9.4	.077	2.1	5.4
	1969	40	7.9	8.5	.066	1.8	4.4
	1968	40	8.3	7.6	.052	1.3	3.3
	1967	40	11.4	6.7	.039	1.2	3.0
	1966	40	11.7	6.6	.027	0.8	2.1
	1965	40	12.1	6.2	.018	0.5	1.4
	1964	40	12.5	5.9	.014	0.4	1.0
	1963	40	12.8	5.5	.009	0.3	0.6
	1962	40	13.1	5.1	.006	0.2	0.4
	1961	40	13.4	5.0	.005	0.1	0.3
	1960	40	13.7	4.7	.005	0.1	0.3
	1959	40	14.0	4.4	.005	0.1	0.3
	1958	40%	14.2	4.4	.004	0.1	0.3
						20.2	56.4

HC: $B_{77} = \frac{20.2}{56.4} = 36\%$

	t	$b_{77,t}$	$e_{77,t}$	$m_{77,t}$	$p_{77,t}$	Numerator Product	Denominator Product
	1977	0%	20.3	15.9	.075	0.0	24.2
	1976	32	24.1	15.0	.107	12.4	38.7
	1975	45	28.2	14.0	.107	19.0	42.2
CO	1974	41	60.8	13.1	.106	34.6	84.4
	1973	46	68.7	12.2	.100	38.6	83.8
	1972	46	76.0	11.3	.092	36.3	79.0
	1971	46	82.8	10.3	.085	33.4	72.5
	1970	46	89.0	9.4	.077	29.6	64.4
	1969	46	94.7	8.5	.066	24.4	53.1
	1968	46	99.8	7.6	.052	18.1	39.4
	1967	46	104.7	6.7	.039	12.6	27.4
	1966	46	106.8	6.6	.027	8.8	19.0
	1965	46	108.7	6.2	.018	5.6	12.1
	1964	46	110.6	5.9	.014	4.2	9.1
	1963	46	112.4	5.5	.009	2.6	5.6
	1962	46	114.0	5.1	.006	1.6	3.5
	1961	46	115.6	5.0	.005	1.3	2.9
	1960	46	117.1	4.7	.005	1.3	2.8
	1959	46	118.5	4.4	.005	1.2	2.6
	1958	46%	119.9	4.4	.004	1.0	2.1
						286.6	668.8

CO: $B_{77} = \frac{286.6}{668.8} = 43\%$

Example 3: The July 1 nationwide mix of vehicles by model year and nationwide estimates of average VMTs apply. An I/M program with a 30% stringency factor is to be implemented in CY 1980. Vehicles will be tested annually, and no mechanic training program will be in effect. Determine the percent reduction in emissions, B_{90}, for HC and CO on July 1 of CY 1990, and the resulting reduced emission factors for HC and CO on July 1 of CY 1990.

Solution: The calculations of B_{90} for HC and CO are performed as outlined in examples 1 and 2. The following tables detail these calculations:

t	$b_{90,t}$	$e_{90,t}$	$m_{90,t}$	$p_{90,t}$	Numerator Product	Denominator Product
1990	0%	0.3	15.9	.075	0.0	0.4
1989	3	0.6	15.0	.107	0.0	1.0
1988	7	0.9	14.0	.107	0.1	1.4
1987	16	1.2	13.1	.106	0.3	1.7
1986	25	1.5	12.2	.100	0.5	1.8
1985	34	1.8	11.3	.092	0.6	1.9
1984	41	2.1	10.3	.085	0.8	1.8
1983	47	2.3	9.4	.077	0.8	1.7
1982	51	2.5	8.5	.066	0.7	1.4
1981	55	2.7	7.6	.052	0.6	1.1
1980	69	2.9	6.7	.039	0.5	0.8
1979	47	4.0	6.6	.027	0.3	0.7
1978	47	4.2	6.2	.018	0.2	0.5
1977	47	4.3	5.9	.014	0.2	0.4
1976	47	4.4	5.5	.009	0.1	0.2
1975	47	4.6	5.1	.006	0.1	0.1
1974	52	10.6	5.0	.005	0.1	0.3
1973	52	10.9	4.7	.005	0.1	0.3
1972	52	11.1	4.4	.005	0.1	0.2
1971	52%	11.4	4.4	.004	0.1	0.2
					6.2	17.9

HC: $B_{90} = \frac{6.2}{17.9} = 35\%$

t	$b_{90,t}$	$e_{90,t}$	$m_{90,t}$	$p_{90,t}$	Numerator Product	Denominator Product
1990	0%	2.6	15.9	.075	0.0	3.1
1989	1	5.3	15.0	.107	0.1	8.5
1988	5	8.3	14.0	.107	0.6	12.4
1987	13	11.0	13.1	.106	2.0	15.3
1986	21	13.6	12.2	.100	3.5	16.6
1985	28	16.0	11.3	.092	4.7	16.6
1984	34	18.2	10.3	.085	5.4	15.9
1983	40	20.2	9.4	.077	5.9	14.6
1982	44	22.1	8.5	.066	5.5	12.4
1981	48	23.7	7.6	.052	4.5	9.4
1980	48	30.4	6.7	.039	3.8	7.9
1979	55	53.8	6.6	.027	5.3	9.6
1978	55	55.6	6.2	.018	3.4	6.2
1977	55	57.3	5.9	.014	2.6	4.7
1976	55	58.9	5.5	.009	1.6	2.9
1975	55	60.4	5.1	.006	1.0	1.9
1974	52	126.2	5.0	.005	1.6	3.2
1973	52	129.2	4.7	.005	1.6	3.0
1972	52	132.1	4.4	.005	1.5	2.9
1971	52%	134.8	4.4	.004	1.2	2.4
					55.8	169.5

CO: $B_{90} = \frac{55.8}{169.5} = 33\%$

The reduced emission factors for HC and CO are calculated using the following formula:

$$ef_{90} = \frac{100-B_{90}}{100} \times \sum_{t=71}^{90} e_{90,t}\, m_{90,t}\, p_{90,t} \Big/ \sum_{t=71}^{90} m_{90,t}\, p_{90,t}.$$

Substituting the appropriate numbers,

HC: $ef_{90} = \frac{100-35}{100} \times \frac{17.9}{11.3} = 1.0$ gm/mi

CO: $ef_{90} = \frac{100-33}{100} \times \frac{169.5}{11.3} = 10.1$ gm/mi.

Table 1

Miles Travelled Per Year of Vehicle Life*

Year	Miles (in thousands)
1	15.9
2	15.0
3	14.0
4	13.1
5	12.2
6	11.3
7	10.3
8	9.4
9	8.5
10	7.6
11	6.7
12	6.6
13	6.2
14	5.9
15	5.5
16	5.1
17	5.0
18	4.7
19	4.4
20	4.4

* Statistics for years 1-11: Strate, H.E. Nationwide Personal Transporation Study-Annual Miles of Automotive Travel. Report Number 2, U.S. Department of Transportation, Federal Highway Administration, Washington, D.C. April, 1972. Statistics for years 12-20: 1972 Census of Transporation Truck Inventory and Use Survey, U.S. Department of Commerce, October, 1973; as summarized by Michigan Technological University in the report EPA-R803782010: The Development of an Emission and Fuel Economy Computer Model for Heavy-Duty Trucks and Buses, August, 1977.

Table 2

Fraction of Vehicles on the Road on July 1 of Calendar Year CY*

Model Year	Fraction
CY	.075
CY-1	.107
CY-2	.107
CY-3	.106
CY-4	.100
CY-5	.092
CY-6	.085
CY-7	.077
CY-8	.066
CY-9	.052
CY-10	.039
CY-11	.027
CY-12	.018
CY-13	.014
CY-14	.009
CY-15	.006
CY-16	.005
CY-17	.005
CY-18	.005
CY-19	.004

* MVMA Motor Vehicle Facts & Figures '77, p. 34. Data averaged over the years 1968-1970, 1972-1976.

The Costs of Inspection/Maintenance

The Clean Air Act Amendments of 1977 underscored the importance of motor vehicle inspection/maintenance (I/M) programs as a key measure in reducing vehicle emissions and helping to achieve the national ambient air quality standards. The Amendments direct that, should a state not be able to demonstrate attainment of the standards for photochemical oxidants (Ox) or carbon monoxide (CO) by December 31, 1982, even with the implementation of all reasonably available measures, a specific schedule for the implementation of I/M must be included in the SIP revisions of January 1, 1979. This commitment is necessary to enable an extension of the attainment date up to December 31, 1987.

I. PURPOSE

Experience to date with vehicle inspection and maintenance programs has shown them to be an effective, practical and cost-effective approach to achieving significant emission reductions from in-use vehicles. But while cost-effective, overall I/M program costs have varied substantially from program to program (See Table 1).

For states which will need I/M, a very important question is what is it going to cost to implement, administer and operate an I/M program in their jurisdiction? The following pages are intended to provide information

to enable states to answer this question. As such their focus is towards costs associated with the administration and operation of the inspection phase though a summary of vehicle repair costs is included later in this section. The major cost categories examined are capital and annual (recurring) costs.

The report (1) discusses what program objectives and variables States should consider in assessing I/M costs; (2) outlines simplified cost analysis methodologies; (3) notes references where more detailed and extensive information can be found and; (4) lists representative cost figures from ongoing I/M programs and recent area-specific I/M feasibility studies. Emphasis was not placed on recounting a host of cost estimates found in previous documentation since the relative accuracy of these figures could not be determined nor could they necessarily provide directly applicable data for areas now considering I/M. Summary tables of these costs are included as appendices to the report.

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Table 1 Characteristics of Selected Existing I/M Programs
Capital and Operating Costs

Last Data Year	Location/ Fee	Test Mode & Type/ Average Repair Cost	# of vehicles/ Capital Cost ($)	% of vehicles failing/ Annual operating cost ($)
1977	Arizona	Contractor; Idle with loaded mode capabilities permanent & mobile facilities; 30 permanent lanes, 1 mobile lane	1.1 million	16.2%
	$5	$23.02	$9.134 million .134 million to Arizona DHS for program development 9.0 million to HTS comprised of (3.6 buildings) (1.4 land) (3.0 equipment) (1.0 personnel)	.5 million Ariz 4.0 million HTS

Table 1 (contd.)

Last Data Year	Location/ Fee	Test Mode & Type/ Average Repair Cost	# of vehicles/ Capital Cost ($)	% of vehicles failing/ Annual operating cost ($)
1978	Oregon: Portland-Metropolitan Service District	State-run; Idle mode with permanent and mobile facilities; 10 permanent lanes, 5 mobile lanes	.58 million	36% (biannual)
	$5	$18.86	$1.2 million for 2 years (181,750 land & building) (203,000 equipment (815,750 administration)	2.25 million total (biannual) (1.34 million personnel) (.416 service & supplies (.163 equipmt.) (.295 admin.)

Table 1 (contd.)

Last Data Year	Location/ Fee	Test Mode & Type/ Average Repair Cost	# of vehicles/ Capital Cost ($)	% of vehicles failing/ Annual operating cost ($)
1978	New Jersey; Statewide	State-run; Idle mode with permanent facilities; Includes safety and emissions; expanded to include garage recertification: 68 permanent lanes	4.5 million	18%
	$2.50	15.83	$0.25 million for equipment; add-on to existing safety facilities with $1.0 million personnel ($32.95 million in original safety & emission facility capital investment)	$10,588,544 total annual operating costs (both safety and emissions) $200,000 rental and $2.0 million personnel associated with emissions

Sources: "Information Document on Automobile Emissions Inspection and Maintenance Programs," Fe. 78, USEPA, GCA Corporation, and conversations with John Elston, Fred Iacobelli and Ron Householder. See also Reference 3.

II. FACTORS INFLUENCING I/M COSTS

Reasons for the relative variability in the costs of an I/M program can generally be attributed to three major areas:

(1) its organizational structure - it is state-owned and operated at centralized facilities; contractor (franchise) operated under State administration at centralized facilities; or private garage operated (decentralized facilities) under State administration;

(2) the type and mode of test employed - emissions test only or emissions piggy-backed with safety inspection; use of idle versus loaded mode exhaust emissions test or other inspection formats and;

(3) the geographic location of the program - noting its population & vehicle density; degree of urbanization; the prevailing labor rates, land and material costs of a reflection of regional market conditions; etc.

The following discussion briefly reviews these considerations and other issues inherently associated with them.

Organizational Structure

A State will wish to choose a particular administrative arrangement for I/M in light of several considerations: the aggregate costs to government and its administrative capability to support an I/M program; the time required for program initiation and implementation; and the degree of public acceptability including measures for consumer protection and convenience. Table (2) outlines the advantages and disadvantages associated with various I/M structures.

A State should assess what level of effort and program functions it would be willing and able to support under the various I/M approaches. For example, a State-owned and operated centralized system would involve more capital outlay to the State for equipment and initial start-up expenses but would entail less administrative, auditing and surveillance costs over time than would a franchise or private garage-based system. The ability to support escalating staff salaries and fringe benefits (labor costs) over time is an important consideration to be weighed versus the beneficial aspects of direct State control of the program.(1)* States which already have experience with some pilot forms of I/M or with safety inspection systems in place may or may not find it desirable to integrate emissions testing into the existing State operations depending upon their test requirements and administrative structure.(2)

*Footnotes refer to technical notes, not bibliographical references.

Table 2 COMPARISON OF ALTERNATIVE I/M ORGANIZATIONAL STRUCTURES: ADVANTAGES AND DISADVANTAGES

	Advantages	Disadvantages
Public Centralized	<u>Consumer Protection:</u> 1. Inspection separate from repair; no conflict of interest. 2. Independent basis for judging the performance of the service industry. 3. Monitoring of instruments' and inspectors' performance facilitated, thereby reducing testing variability. 4. Designed specifically for high capacity emission testing	<u>Consumer Convenience:</u> 1. Fewer inspection facilities than with decentralized systems, thus an increased probability of longer travel and wait. <u>Cost</u> 1. Start-up requires large public capital outlay if land and equipment acquisition and building construction is necessary. 2. All program costs born by public sector. 3. Risk of increasing long-term fixed costs to government due to increase in number of potential retirement/pension beneficiaries. 4. Long lead time for land acquisition and construction.

Table 2 (cont.)

	Advantages	Disadvantages
Public Centralized (continued)	**Cost:** 1. Potentially lower (inspection) labor costs compared to decentralized systems can mean lower recurring costs. 2. More efficient use of equipment than in decentralized systems, economy of scale of multi-lane stations. **Information:** 1. Data collection facilitated; benefits from computer applications 2. Loaded mode testing possible.	**State Convenience** 1. Will sometimes require that state must obtain land. 2. Relatively greater number of state employees to hire than other options.

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Table 2 (cont.)

	Advantages	Disadvantages
Centralized (Contractor-Operated)	Consumer Protection: same as public centralized Information: same as public centralized	Consumer Convenience: same as public centralized
	Cost: Same as public centralized, plus 1. All program costs born by private sector except those associated with administrative oversight. 2. No risks of increasing long-term fixed governmental costs. 3. Permits use of corporate tax structure to reduce burden of start-up capital expenditures.	Consumer Protection 1. Possible adverse public reaction to corporation earning profits from "captive market." 2. Potential for extensive and costly State administrative functions to monitor contract. 3. Start-up time less than State but more than decentralized approach.
	State Convenience 1. Private sector may be able to obtain land and hire new employees more readily than a state agency.	
	Information 1. Data collection and handling can be part of contractor's duties.	

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Table 2 (cont.)

	Advantages	Disadvantages
Private (Service Industry) Decentralized	Consumer Convenience: 1. Greater number of facilities increases probability of minimizing travel and wait times. 2. Possibility for one-stop inspection/maintenance; with most safety inspection programs being decentralized, offers easy combination of tests. 3. Training of inspectors involves direct contact between state and service industry; can promote communication necessary for proper implementation of program.	Consumer Protection: 1. Inspection not separate from repair: presents potential for conflict of interest which requires active state oversight. 2. No independent basis for judging performance of service industry. 3. Effective monitoring of inspectors and instruments is substantially more difficult.
	Cost: 1. Lower start-up costs for state than in public centralized system; reduces financial burden of state-captial investments. 2. All operating program costs born by private sector except administration and monitoring.	

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Table 2 (cont.)

Private (Service Industry)
Decentralized (continued)

Cost:

1. Generally high labor costs for monitoring of licensed stations can mean high recurring costs.
2. Less efficient use of equipment than in centralized systems
3. Inspector training involves greater numbers than in centralized systems and is therefore more costly.

Information:

1. Uniform and detailed data collection is more difficult.
2. Loaded mode testing is difficult if not impossible.

Sources: See references 3, 8, and 14.

Scheduling for I/M initiation and implementation varies according to system type. State or publicly-operated centralized systems generally require more start-up time than decentralized, private systems. Centralized I/M programs are capital intensive requiring the purchase of land, buildings and test hardware.(3) States usually require competitive bidding procedures to be followed for each of these cost categories and the time required between legislation and actual operation is comparatively longer than other systems. While a franchise system involves many of these same contracting procedures the necessary start-up period is usually less since only one contract agreement is necessary for operation of the many aspects of the system.(4) A private decentralized approach is expected to take the least time to initiate because of the immediate presence of inspection sites and the purchase of equipment is by the garage owners.(5)

Public acceptability is probably the most important consideration influencing organizational structure, I/M costs, and the success of I/M overall. The public's acceptability of I/M is determined not only by the amount of out-of-pocket expenses incurred and the perceived benefits but by the guarantee of consumer protection and the relative convenience of the program. Consumer protection and consumer convenience are functions of both the I/M system (centralized, decentralized) and its ownership (public, private). Centralized systems due to their potentially higher lane capacity, require fewer inspection sites.

*Deadlines for I/M implementation are included in USEPA's policy paper on I/M issued on July 17, 1978[4]. See reference 15.

The reduced number of sites allows more effective monitoring of inspectors and equipment, thereby reducing test variability due to variations in inspector and instrumentation performance. This results in a decreased possibility of error in measuring vehicle emissions. The smaller number of sites also means that a smaller total number of personnel are involved in providing inspections; hence, lower inspector training costs are incurred.(6) The private garage system, while offering the convenience of combining both inspection and maintenance functions, presents a potential conflict of interest since the mechanic who determines whether or not a car must be repaired also stands to gain business from this determination.* A State-run centralized system offers a distinct inspection phase versus a repair phase thereby removing the possible conflict of interest, thus removing one source of possible public dissatisfaction.

A franchise scheme would be equally as acceptable to the public as a State-run system if it was assured that the contractor was not involved in the parts or repair industry and that the State is effectively and objectively monitoring the contract.

* To assure the integrity of such a system, the State must maintain an effective monitoring and unannounced audit program of licensed stations.

Type and Mode of Test Employed

The type of inspection may be an emissions-only inspection or an emissions and safety inspection (costs associated with incremental programs, emissions add-on to safety, are discussed in another section). The test mode employed may be idle or loaded. Both test type and mode affect I/M program characteritics, particularly the vehicle processing or through-put rate and hence the number & size of stations and the attendant staff required.(7).

If either an idle or loaded mode exhaust emissions test is adopted the State should consider the trade-offs between equipment cost and extensiveness of emission information.(8) The loaded mode test employs the use of a chasis dynamometer and usually more expensive computer processing equipment in order to obtain vehicle emission readings more reflective of actual urban driving conditions.(9) While the information gained is more complete, equipment costs are greater than with the idle mode. These costs may be offset over time because the degree of automation employed reduces the total number of inspection personnel that might be required for the manual inspection procedure. The idle test mode, at the minimum, requires minimal hardware (probe, analyzer, etc.) and personnel necessary to take readings and process vehicles. The idle mode does not preclude the use of more sophisticated data handling equipment, however. The loaded mode necessitates permanent facility construction or modification (except where used with a mobile van and trailer) and would virtually eliminate the possibility of use in a private, decentralized system.

The State may also wish to consider employing test alternatives other than idle or loaded mode exhaust emission testing, such as parameter inspection and mandatory maintenance. Completed studies have suggested, however, that such alternatives are not as cost-effective as exhaust emission tests. For example, Olson Laboratories in 1976(10) produced a study which indicated that while parameter inspection and mandatory maintenance have the potential to provide for substantial emission reductions, they generally cost significantly more than an idle test. With the exception of the type and cost of equipment utilized, the State can expect to incur approximately the same types of expenditures as with exhaust emission inspection alternatives. Generally inspection times are significantly greater, thereby affecting vehicle capacity and system configuration. Surveillance, certification, and training requirements may also be more costly depending on the number and type of adjustments involved.

The Effect of Geographic Location

Evidence from existing I/M programs generally confirms that program location affects both I/M capital and annual costs. For instance, costs for labor, land, building and construction, and equipment all can be greater in the northeastern United States than in the western and southern portions. Salaries, fringe benefits & inspection site land values are all subject to regional price variation. Table (3), for example, notes the variation in land and inspector cost requirements for various existing and proposed I/M programs.

Table 3

PRICE VARIATION IN LAND ACQUISITION COSTS AND INSPECTOR SALARIES FOR SELECTED I/M PROGRAMS AND STUDIES

Location	Year	Cost per sq. ft.	Annual Inspector Wage Rates ($)
Denver	1974-75	$2-3	9,500
Portland	1975	$2.75	10,944(a)
Cincinnati	1976	$.92	9,893
St. Louis	1976	$1-30.00	11,000
Chicago	1974	$4	NA
New Jersey	1975	$1-9.00	11,233
California	1977	N/A	13,488(b)

(a) 1978
(b) See reference 9

Source: See references 3, 4, 10, 20 & 22

III. CATEGORIES OF I/M COSTS

As noted earlier there two major areas of costs associated with initiation of implementation of an I/M program - capital and annual (recurring) expenditures. Capital investments can include the purchase of land, buildings and test hardware. Also possibly included are construction and installation costs & initial program start-up costs including the administrative expenses of detailed program design and evaluation, inspector and supervisor training, public relations and education, laboratory testing for standard documentation and where applicable, mechanics training. Annual costs generally include: building and site rentals or leases; personnel salaries and fringe benefits; daily operating expenses, overhead, equipment amortization and replacement; and the on-going aspects of public education, staff training, enforcement and program monitoring and evaluation. However the primary component of annual or recurring costs is the cost of labor.(11) Table (4) summarizes the various effects on annual and capital costs by the variables of organizational structure, test type and mode and program location noted earlier. Table (5) provides a more detailed delineation of responsibility of program components costs according to organizational structure.

IV. SAMPLE COST DETERMINATION PROCEDURES AND CONSIDERATIONS

In this section, simplified cost analysis procedures are provided so that the prospective program manager, given area-specific data, can preliminarily assess costs of alternative I/M systems. Several important points to

consider throughout the analysis of costs are the unique characteristics of the area, its existing resources, and the necessity of public acceptance. Included in Section 3.2 is a sample worksheet illustrating application of the cost process.

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Table (4)* - FACTORS INFLUENCING I/M COSTS

	CAPITAL COSTS	ANNUAL COSTS
ORGANIZATIONAL	- Org. Structure determines how distributed and to who - Building costs generally greatest though land costs can vary - In centralized system there are heavy site, facility & equipment costs; contractor bears this expense in franchise system; private garage needs equipment only but greater # of analyzers evens aggregate costs out	- In public centralized system, State pays for both inspection personnel and administration; in contractor system, administration expands to include monitoring of contract and inspection personnel costs are greatly reduced if not eliminated; decentralized systems necessitate a significant state monitoring and enforcement effort along with basic program administration - Public, centralized system may have to pay long term fixed obligations to employees whereas contractor does not
TEST TYPE AND MODE	- Failure & thruput rates are affected; combined safety & emissions test takes longer and consequently a greater lane capacity is needed - Centralized systems have larger facilities; decentralized systems have more inspection sites w/greater equipment needs	- Because failure & thruput rates are affected, number of required inspectors is greater w/ combined safety/emissions program where inspection time & failure rate are greater

Table 4 (continued)

	- Loaded mode requires more equipment, costs more and takes longer; building costs greater; private garage generally precludes use of loaded mode	
PROGRAM LOCATION	- Considerable variation in land & construction costs - Interregional & intermetropolitan price variation - Station location costs depend upon density, transportation system and demographic characteristics of the area	- Gross salary & fringe benefits affected - Higher wage rates in denser northeast & north central regions

*Source: From Reference 3.

State-Operated, Centralized System Costs

The first procedure listed pertains to initial capital investment costs for a state owned and operated I/M program. Some of the steps will be duplicated for the cost analysis of other systems. The procedure is as follows:

(1) estimate applicable affected vehicle population accounting for the geographic area covered and according to vehicle types tested (weight range, model year, etc.) - obtain data from motor vehicle department records, census data, survey information and transportation planning data;

(2) locate existing and projected vehicle population according to planning zone, etc. determining the relative population and vehicle densities or concentrations;

(3) determine the number of vehicle inspections per year to be performed by taking figure derived in Step 1 plus the failure rate (10, 20 or 30% etc) times that figure (i.e. initial tests plus necessary retests);

(4) determine the vehicle throughput or processing rate - account for inspection test mode time, hours of facility operation, actual days of operation, operating efficiency (installed vehicles, inclement weather, inspector fatigue, unforeseen delays, etc.);(12)

(5) determine the total number of lanes required by dividing the total number of inspections by the lane throughput capacity;

(6) accounting for vehicle density, vehicle growth, locational criteria (environmental compatiblity, travel time, proximity, land availability) allocate lanes (and stations) to appropriate sub-areas;

(7) determine site location requirements and acquisition costs-account for land values; account for necessary acreage (capacity) needs according to number of lanes and station design (as influenced by test mode); account for expected facility expansion over time (if applicable) from growth found in Step 1; illustrates costs per square foot and per acre; research real estate values; compare cost rental or lease agreements to cost of ownership over time;(13)

(8) determine site preparation costs-account for landscaping, soil conditions, necessary street imporvements, sewer and water costs, electricity costs, other improvements including paving sidewalks, curbs, parking, signs etc; determine basic single lane costs and then modify for multiple lanes needed and hence station costs (account for economies scale or size);

(9) determine facility construction costs-account for station design and capacity (architectural & engineering fees); account for projected expansion due to change in test mode if necessary; account for support function costs (lab, office, storage); account for structural costs (including construction labor) on a per lane basis;(14)

(10) determine total equipment costs including test equipment, station support equipment and general office equipment (include analyzers and where applicable dynamometer, air compression equipment, fans, tools, contingencies, computer record and read-out hardware, etc.); account for replacement and maintenance;(15)

(11) sum site acquisition, preparation, facility construction and overall equipment costs;

(12) determine initial program design, testing and evaluation costs-account for program planning, engineering and design fees, research and development;

(13) determine the level of effort and associated costs required for public information and education (including media spots, printing, free program tests, seminars, etc);

(14) determine administrative start-up costs including initial employee training for management, inspection and enforcement functions;

(15) total 11 through 14 for total initial capital investment; captial costs may be amortized generally over a 5 or 10 year time span give the life of the program and interest rate.

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Table (5) Summary of Cost Categories and Components Associated with I/M Implementation Costs to the State Under Various Systems

Cost Category	System Type: Public Centralized	Private Contractor	Decentralized Private Garage
Capital Costs			
Site Acquisition	+	x	N/A
Site Preparation	+	x	N/A
Facility Construction	+	x	0 facility modification
Equipment Costs	+	x	0
Administrative Start-Up	(All+)	-	(All+)
-Program Design, Testing & Evaluation		+;x	
-Public Information & Advertising		+;x	
-Programming & Computorization		+;x	
Training, Supervision & Enforcement	+	+,x station Inspector training Lane inspectors training Rest is state supervision & enforcement	+
Mechanics			

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Annual Costs

Amortized (Capital Costs	+	+adm., x oper.	+adm., 0 oper.
General Station Operating	+	x	0
Expenses	+		
Salaries & Fringe Benefits	+	+adm., x oper.	+adm., x
Replacement Costs & Contingencies	+	+,x	+0
Recurring Costs			
-Program Evaluation	+	+	+
-Inspector Training	+	(see above)	+
-Public Education	+	+,x	+
-Mechanics Training	*	*	0

Responsibility

State + Contractor x Private Garage 0

NOTE - N/A = Not applicable
- Mechanics training programs can be developed by the State through community college courses or special programs or may be taken by mechanics through the service industry.

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Analysis of annual costs for State-operated centralized facilities should:

(1) determine general station operating costs-account for utilities, office equipment and supplies, cleaning and refuse service, phone service, etc.;

(2) determine administrative field and inspection station personnel salary, fringe benefit and pension requirements - account for operating personnel per station and needed overtime; include base wage plus cost of living & merit increases and fringe benefits; account for administrative, surveillance and repair facility contact personnel; account for data processing personnel, etc.; account for on-going program evaluation costs;

(3) account for equipment depreciation, replacement and amortization of capital costs over time.

Thus in figuring a total outlay for a State-run centralized sysytem for a single jurisdiction:

(1) amortized costs - capital costs x financed period x interest rate;

(2) yearly program costs - amortized costs + operating expenses; and

(3) cost per vehicle (owner) per year (i.e. inspection fee) = yearly program costs divided by total number of applicable affected vehicles (assuming retests are free).

All of the above computations must account for the effects of inflation and other cost escalation considerations. Rates will vary among cost sectors and geographic location (land values, equipment costs and personnel salaries are particularly affected). While each State should determine what adjustments are necessary for its particular situation, several (states have been employing annual inflation factors from 5 to 10%.(16)

Contractor-Operated, State Administered, Centralized System Costs

With a private centralized system the cost analysis procedure is much the same as with the public, centralized system. While the ultimate fee to the consumer can be calculated by the relatively same process, the costs to the States would be distributed differently

among program components. The contractor would absorb the bulk of capital expenditures and recurring labor costs. The State's expense would rest primarily in administrative areas - auditing, surveillance, program evaluation and consumer protection. Under a private, centralized system the State would invite competitive bids from various contractors. Based upon program conditions (stringency of the standards, affected vehicles, test mode) outlined by the State, the most qualified proposal would be selected. The State could determine, on the basis of the contractor proposal:

(1) the level of management (administrative and clerical) and program evaluation staff required, including the personnel needed to ensure proper implementation of the contract;

(2) the number of State inspectors required to monitor the stations called for by the contractor (and the station equipment);

(3) the number of State inspectors required to handle complaints; and

(4) the need for any additional quality control or consumer protection measures.

The same cost analysis procedure used for determining state, centralized system expenses can be employed to check the cost proposals of various contractor submissions.

The contractor and State would negotiate a detailed agreement outlining the specific responsibilities and expectations of each party and detailing, according to vehicle population and changes in various cost components over time, the scale of fees to be charged and the respective portions due to the State and contractor. The number of oversight State personnel to ensure proper implementation of the contract is probably the most important administrative consideration for the State.

In some instances involving large vehicle populations the private contractor approach has shown that the I/M program can be mobilized more quickly at a per vehicle cost equal to or less than that of the public, centralized approach and much less than that of the private decentralized approach.(17) This is because the contractor can move more rapidly in site acquisition and facility construction and has more flexibility in the use of its employees. The contractor is bound by the negotiated agreement to certain dollar levels and time periods. This assures the State a relatively stable I/M program. Unfortunately should the State renign on a negotiated agreement with the contractor, the State may be liable to reimburse the contractor for all his expenditures to date.(18)

Private Garage, Decentralized Facilities

Many of the considerations in the costing analysis for public, centralized systems are inherent to the analysis of decentralized systems, as well. The State must determine the total number of affected vehicles and inspections expected. The initial difficulty with garage-based I/M programs is the uncertainty concerning the number and location of participating garages relative to the vehicle population. The number of private service stations and garages licensed to perform vehicle inspection affects the amount of time each station must spend on inspection. This in turn affects vehicle processing rates and inspection fee levels. In any regard more than a sufficient number of garages can be expected to participate.(19)

Once the number of participating stations is gauged (most likely through survey or polling) the State would be able to determine:

(1) the administrative costs of certification, surveillance and enforcement;
(2) the State inspector requirements - in consideration of total inspection time and workload, travel time, number of certified facilities and frequency of inspection;
(3) the State inspector costs - number of inspectors required, salaries and fringe benefits over time, training costs;
(4) the costs associated with program evaluation, processing of data, and public relations and education; and
(5) the cost of instituting a State challenge lane facility for consumer protection.

With a private, garage-based decentralized system large capital expenditures for land and buildings are not required. The participating service stations need only purchase emissions testing equipment and have their mechanics undergo the appropriate training to be certified for emissions testing and repair. The State, while relieved of the costs of site acquisition, construction and maintenance, except possibly for state challenge land facilities) may experience greater overall administration costs under this system primarily due to the increase in surveillance and auditing requirements. The cost of the inspection to the consumer may be greater than in a centralized system due to the significantly higher hourly wage rates of garage mechanics and the longer amount of time required to perform the inspection.(20) However, the relative inspection fees for decentralized versus centralized systems depend on many factors, and local comparison of various program options is advisable.

V. COSTS AND CONSIDERATIONS OF INSPECTOR AND MECHANICS TRAINING

A key component in the degree of public acceptability of an I/M program is the quality & reliability of work provided by the automobile repair industry. In order for the program to be successful it is imperative that any inspectors of the administering jurisdiction as well as mechanics conducting testing or vehicle repair work be properly knowledgeable.

The emissions inspector must have first hand knowledge of the test procedures, operation and care of inspection instrumentation, and engine components which contribute to excess HC, CO and NO_x emissions. Mechanics need to understand the function and maintenance of emission control devices, which engine parameters affect emissions, and how to properly tune vehicles to minimize emissions while optimizing performance and fuel economy.

EPA-sponsored training programs conducted by Colorado State University (CSU) are intended to address these training needs. Vocational-educational schools and community colleges across the United States have adopted the EPA-CSU courses. By placing these courses within the framework of the local eductional system, this knowledge becomes readily available at a reasonable cost. The State is not the only source for mechanics training programs,

of course. Various sectors of industry - motor vehicle manufacturers, petroleum companies and emission analyzer firms - also offer courses to train mechanics for competency in dealing with emission control and instrumentation.

Estimates of the costs of training mechanics and emissions inspectors vary.(21) Table (6) lists the most recent and reliable cost approximations for the various training categories as provided by CSU. Mechanics training refers to training of mechanics for necessary diagnosis and repair. Referee lane training is the most comprehensive approach involving the understanding of all aspects of program operations, test procedures, diagnosis and repair. Investigator training refers to training of the inspectors of inspection stations. It also is more comprehensive than general inspector training which is essentially geared towards operation of the idle test process-vehicle preparation, probe insert, instrument reading, vehicle processing, etc.

Table 6

Costs of Inspector and Mechanics Training

Training Type	Direction of Instruction	Class Size	Number of Instructors	Salaries Overhead Direct Cost $	Number of Persons Trained	Cost per Person Trained ($)
Mechanics Training	16-20 hrs.	16-18	2	125,000	1050	120
Referee Lane Training	50 hrs.	25	2	15,600	25	675
Investigator Training	40 hrs. approx.	N/A	2	N/A	N/A	570
Inspector Training (Idle Mode)	8 hrs.	30	1-2	N/A	N/A	70-95

Source: Information supplied by Marion Maness, Colorado State University, August 1978.

VI. INSPECTION AND MAINTENANCE ENFORCEMENT AND SURVEILLANCE COSTS

Enforcement of an I/M program will necessarily involve the ensuring vehicle owner compliance with inspection requirements. In a number of previous I/M studies, cost analyses failed to account for enforcement costs.(22) There are generally two mechanisms employed to enforce the program: (a) Withhold registration based upon test records and follow-up by law enforcement officials and; (b) withhold an inspection sticker which must be displayed for vehicle operation on public roads. Citations could then be issued to those without licensed plates or a valid inspection sticker. Citations may also be issued during random roadside checks by law enforcement or program officials. Estimates of enforcement costs have generally found them to be no more than 1% of the total annual program costs for a State operated program.(23) Enforcement costs can be expected to be higher for programs that involve vehicles from neighboring jurisdictions. Where I/M authority rests with a city or county alone, enforcement of vehicles registered outside its boundaries can be effective only with close interjurisdictional cooperation.

Surveillance costs for the monitoring and certification of private garages, generally translate into personnel (investigator) and administrative (record-keeping) costs. Inspectors must ensure that emission analyzers are in proper calibration and that the licensed stations are following all rules and proper procedures. When assessing surveillance costs the State should consider:

(1) costs of investigator or inspector training;

(2) their salaries and fringe benefits;

(3) their daily expenses, travel, mileage, etc.;

(4) their inspection rate (in stations-per-inspector-per-month) and the number of private garages to inspect (thus the total need for inspectors can be determined); and

(5) the salaries and benefits of personnel needed to process private garage data and maintain records plus any associated software, hardware and equipment costs. (key punch, computer, survey forms, etc.)

One example of the number of personnel needed to monitor a program is the State of Rhode Island which maintains a force of 30 inspectors for about 700 licensed stations and 500,000 vehicles for both safety and emissions.(24)

Surveillance costs can be recouped of course by charging the private garages a certification fee. The private garages generally pass this cost along to the vehicle owner. Thus by requiring more extensive administrative demands on the State, the costs of private garage certification may tend to raise the inspection fee.(25)

VII. PUBLIC AWARENESS AND EDUCATION

The important consideration in this area is not the total number of dollars expended but the quality of public relations effort produced. Generally a prerequisite condition to the initiation of a full-scale public relations effort is the choice of the I/M system and test mode. Indications of the public acceptability and the practicality of various I/M alternatives can be gained from a demonstration effort. The timing of public information efforts is important as well. While there should be an initial push for I/M, public relations expenditures should be continuous throughout the life of the program.

The following materials and strategies have been utilized for I/M outreach:

(1) information pamphlets, press releases, and newspaper ads and articles;

(2) radio and TV spots including public service announcements;

(3) bumper stickers, educational posters and displays;

(4) audiovisual presentations including slide shows;

(5) free auto-care clinics with mobile testing facilities and;

(6) soliciting media involvement, obtaining speakers, organizing information efforts and subcontracting to public interest groups to conduct programs to inform various organizations.

VIII. INCREMENTAL EMISSIONS TESTING PROGRAM (SAFETY INSPECTION ADD-ON)

Many States have existing forms of vehicle safety inspection programs already in place. Twenty-four states use service stations o garages licensed by the State for inspection while three states and the District of Columbia have centralized public programs. Because of the widespread existence of safety inspection programs, the combination of safety and and emissions testing frequently must be considered.

The type and mode of emissions test must interface compatibly with the existing safety inspection program. For example if a loaded-mode emission test is desired for a private garage-based safety program then those stations would be faced with having to tie up their service bays and install dynamometers at a significant cost outlay to them should they decide to participate. For this reason it is generally impractical to initiate a private garage system with loaded testing. It is much more likely that some form of a centralized system could reasonably achieve this.

Idle emission tests are therefore easier to add to existing safety programs. State of New Jersey has successfully instituted an idle emissions test at its centralized safety inspection facilities while avoiding possible disruptive effects on the program. The New Jersey inspection program began in 1938 with safety inspections and now includes emissions testing, registration and license check and insurance certification.(26) The City of Cincinnati has also demonstrated the viability of adding an idle test to a safety system.

A second consideration is that a test for emissions and safety typically fails a higher percentage of all vehicles inspected and takes more time on average than does an emissions only test. As a result a combined emissions and safety inspection program requires greater lane capacity than an emissions only test, giver the same vehicle population. For centralized systems this may either mean a greater number of facilities are required or a more intensive use of existing facilities. For example, New Jersey found it necessary to expand its program to include emission retests at certified garages. The State estimates that initially, $1.25 million in costs were added to its safety program.(27)

However, in terms of convenience to the state adding emissions testing to an existing safety program generally is rather straightforward. An administrative and surveillance network has already been established. States investigating incremental approaches should most importantly consider consumer convenience, consumer acceptability and administrative & operational efficiency.

IX. INTRODUCTORY OR DEMONSTRATION I/M PROGRAMS - COST AND CONSIDERATIONS

Instituting an introductory or pilot form of I/M provides a logical transition to the implementation of a full-scale program. Operating an introductory I/M program can enable a jurisdiction to:

(1) promote public awareness and acceptance - by explaining the rationale and benefits of I/M and assuring the provision of adequate consumer protection;

(2) gain useful information on the vehicle population - emission levels, recommended stringency factor, repair rates and ceilings, etc.;

(3) become more adept at program management, technical training and the handling of technical issues; and

(4) develop the appropriate cutpoints or standards for the program.(28)

Costs for an introductory program are actually dependent upon how sophisticated or extensive a State wishes it to be or what a State can reasonably afford. The format can be based on what program aspects a State would like to investigate or document (e.g., - relative advantages of idle versus loaded mode; model line - specific cutpoints etc.) or the State may wish to institute a dry-run of a scaled-down version of its eventual full-scale I/M program.

Introductory approaches can include but are certainly not limited to the use of mobile vans or a centralized test facility for voluntary vehicle testing. They may also involve for example: voluntary testing, the inspection of vehicles at time of a change of ownership; or mandatory inspection with voluntary maintenance for all light duty vehicles.(29) Below are several brief summaries of approaches to introductory I/M programs.

(1) Well-publicized demonstration lanes can acquaint many people, either in person or by mass media, to I/M. Free tests can be provided with explanations of the need and benefits of vehicle I/M.

(2) Mobile vans can be employed in a continuing introductory program to avoid the higher costs of permanent facilities. Several sources have placed the cost of single unit, fully-equipped with loaded mode test capability, at $30,000 to $50,000 (manpower not included).(30) Mobile vans were employed by the State of Oregon as part of their initial I/M efforts.

(3) The State of California will begin operation of mandatory I/M for vehicles requiring registration changes in March 1979 within the South Coast Air Basin. The program will be operated by a private contractor. Over 1.7 million idle mode inspections are anticipated to be performed at centralized facilities. This program supersedes California's earlier use of its permanent Riverside test facility which tested 120,000 light duty vehicles under a mandatory inspection and voluntary maintenance format. Original capital costs for the Riverside facility totaled $250,000.(31)

X. FINANCING THE SYSTEM; COSTS TO THE CONSUMER

The three major cost categories of inspection/maintenance programs-capital, annual,and repair costs - each have different means of financing. The financing methods for the first two categories vary according to a program's organizational structure.

Costs associated with capital investment have been financed, in centralized public systems, through the current budget of the affected jurisdiction. The funds needed to establish the I/M program have either been appropriated directly to the vehicle inspection program or the program has borrowed money from another state agency.(32) These funds may possibly be recouped by inspection fees. Limited experience with centralized contractor systems seems to indicate that such arrangements have a capacity to use the corporate tax structure to cover capital expenditures over time. Such an arrangement effectively shifts the burden of financing the capital investment for I/M from the State to the Federal government. There is insufficient data available on capital financing mechanisms for private decentralized systems. However, assuming that the capacity to write-off capital expenditures is a function of the type of ownership, private decentralized systems would share the same financing advantages as centralized, contractor systems. Like capital costs, annual costs in both public and private centralized systems can also be financed from the current State budget.(33) I/M is generally a self-supporting program, however, since the revenues generated usually cover operating expenses and generalized capital costs.

Ultimately, virtually all costs are born by the consumer, whichever I/M program option is chosen. I/M costs to the consumer are comprised of of the inspection fee and the I/M - related maintenance and repair costs (when necessary). Some states have minimized consumer costs with vehicle repair cost ceilings and exemptions.(34) The inspection fee is generally designed to cover the program's capital and annual costs.

Several states with existing I/M programs have found that an inspection fee of $5.00 is adequate to cover program costs (See Table 1).

Studies for other States have projected comparable inspection fees.(36) Fees have ranged from $2.50 in New Jersey (with both safety and emissions) to $14.00 in California*(for the change-of-ownership program).

The overall fee should generally not be significantly more than that needed to sustain a self-supporting operation. The exception is in the case of a contractor-operated I/M program where a reasonable profit is included for the incentive of the contractor.

Recent information from existing I/M programs on repair costs indicates a range of average costs for failed vehicles of $16 to 32. Table (7) provides a more detailed percentage distribution of costs according to general cost categories.

* This fee covers ongoing reimbursements to the Motor Vehicle Account of the California Transportation Tax Fund. A substantial loan from the Account supported the Riverside pilot program.

Table 7

I/M Repair Costs

New Jersey

Less than $10	29.7%
$10 - $25	26.4%
$25 - $50	22.1%
$50 - $100	16.1%
Over $100	5.6%

N = 16,000
Average repair costs = $32.40*
Median - 50% of repair cost less than $20
65% of repairs cost less than the average

Oregon

No Cost	27%
$0 - $10	37%
$10 - $30	18%
$30 - $50	8%
$50 - $75	5%
Over $100	2%

N = 1400 (primarily newer cars)
Average repair costs = $16.00
Median - 50% of repairs cost less than $8
71% of repairs cost less than the average

Arizona

Less than $5	27%
$5 - $10	17%
$10 - $25	24%
$25 - $50	20%
$50 - $100	10%
Over $100	2%

N = 2000
Average repair cost = $23.40
Median - 50% of repairs cost less than $15
64% of repairs cost less than average

Table 7 (continued)

Failure Rates -	New Jersey	- 12% (annual)
	Arizona	- 16% (annual)
	Oregon	- 36% (annual)

Source: See Reference 24

*New Jersey's average costs dropped to $15.86 in 1977.(36)

XI. SUMMARY

This section has reviewed various cost components that affect the overall costs of an I/M program. The main focus was on the costs to the state or other administering jurisdiction. It must be emphasized however that local factors individual to each area have a very strong influence on how much an I/M program will cost. While the figures presented here should give some sense of the magnitudes of the costs involved, a cost analysis should be performed for any new I/M program.

APPENDIX

Tables of Selected I/M
Program Cost Estimates
(Reference 3)

CHART A

CAPITAL COSTS FOR EXISTING PROGRAMS

Location	Organizational Structure	Test Type	Test Mode	# Lanes	Administration	Equipment	Buildings	Land	Total
New Jersey	State Owned and Operated	Safety and Emissions	Idle	60	$2,400,000	250,000	25,500,000[a]	4,800,000	$32,950,000 485,000/ lane
Cincinnati and Norwood, Ohio	City Owned and Operated	Safety and Emissions	Idle	4	None accounted for	600,000[a]		200,000-400,000	800,000-1,000,000 200,000/ land
Chicago	City Owned and Operated	Emissions	Idle	18	600,000	1,254,000	460,000[f]	460,000	3,840,000 213,300/ lane
Portland, Oregon	State Owned and Operated	Emissions	Idle	15	800,000[d] Financing: 15,750	203,000	107,750[b]	74,000[c]	1,200,500 80,000/ lane
Riverside, California	State Owned and Operated	Emissions	Loaded	6	450,000 Financing: 320,000	580,000	Leased		1,350,000 225,000/ lane
Maricopa and Pima Counties, Arizona	Franchise	Emissions	Loaded	37	1,132,000	3,000,000	3,600,000	1,400,000	9,132,000 247,000/ lane

a. Estimated Replacement Value
b. 1 permant building and six mobile vans
c. Estimated Value - Actually leased for $1/yr. from State Highway Department
d. Includes 18 months operation costs for pilot program
e. To date
f. Includes cost of 12 vans
g. Rough estimate of value - land previously owned by city so acutal expenditure = $0.

CHART B

RECURRING COSTS FOR EXISTING PROGRAMS

Location	Organizational Structure	Test Type	Test Mode	# Lanes	Administration	Inspection	Other	Total
New Jersey	State Owned and Operated	Emissions and Safety	Idle	68	Gross Salary: $426,000 Fringe: 106,500	Gross Salary: 491,176 Fringe: 1,872,941 PPO: 300,000[d]	Lease: 200,000 Overhead, Supplies: 850,000	11,236,617 165,240/lane
Cincinnati, Ohio	City Owned and Operated	Emissions and Safety	Idle	4	305,000[a]		Non-Personnel: 50,000 Special: 100,000[b]	535,000 133,750/lane
Chicago	City Owned and Operated	Emissions	Idle	10	160,224[a]	819,264[a]	"Goods and Services" 600,000	1,579,488 87,750/lane
Portland Metropolitan Service District, Oregon	State Owned and Operated	Emissions	Idle	15	Gross Salary: 126,000 Fringe: 21,042	Gross Salary: 703,560[c] Fringe: 117,405	Lease: 81,600	1,049,600 70,000/lane
Riverside, California	State Owned and Operated	Emissions	Loaded	6	Gross Salary: 169,344 Fringe: 27,942	Gross Salary: 356,008 Fringe: 58,873	Lease: 255,360 Equipment Replacement 100,000	960,300 161,390/lane
Maricopa and Pima Counties, Arizona	Franchise	Emissions	Loaded	17	350,000IMS[a] 330,000Ariz.	3,700,000[a]	Public Relations 250,000	4,630,000 125,135/lane

a. Including fringe
b. Includes some unusual expenses, e.g., photographic equipment and supplies used to document "unroadworthiness" of cited vehicles.
c. Gross salary for 75 employees in a reregistration year; for an off year when only cars changing registration are required to be inspected, there are 27 inspection staff; Gross salary $272,404/year; fringe: $45,505/year
d. PPO = Premium Portion of Overtime: like fringe benefits, this is not accounted to either the DEP or DMV budget, but is paid directly out of the New Jersey State Treasury.

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CAPITAL COST ESTIMATES FOR PUBLICLY OWNED AND OPERATED SYSTEMS

CHART C

DATA SOURCE	# LANES	TEST MODE	ADMINISTRATION	EQUIPMENT	BUILDING/CONSTRUCTION	LAND	OTHER CONTINGENCIES	TOTAL
EPA, OTLUP MSED	2	IDLE	$5,000	9,400	60,000	14,000-140,000	4,900-7,000	$93,300-221,400
EPA, OTLUP MSED	2	LOADED	5,000	17,800	60,000	14,000-140,000	4,500-10,800	101,300-237,600
BATTELLE, TCP 5/75	2	IDLE	3,000	16,870	35,000	14,000-140,000	AUTOMATION: 14,850 CONTINGENCIES: 4,090-7,000	87,810-216,720
BATTELLE, TCP 5/75	2	LOADED	3,000	24,270	35,000	14,000-140,000	AUTOMATION: 14,850 CONTINGENCIES: 4,500-10,800	95,620-227,920
"CONTROL STRATEGIES FOR IN USE VEHICLES," '74	2	IDLE		26,720	87,500			114,220
"CONTROL STRATEGIES FOR IN USE VEHICLES," '74	2	LOADED		38,720[a]	90,500			129,220
OLSON, SCAB, VEI STUDY 5/75	2	LOADED	26,600[c]	99,500[a,b]	NEW: 144,600 REHAB: 12,000	94,300 132,000		365,400 270,100
NEW YORK, '74	2	LOADED		29,796	68,932	130,592		229,320
NEW YORK, '74[d]	2	LOADED		62,430	264,075	125,996		432,501
DENVER TRW, '74	2	IDLE	7,039	17,194	48,513	30,323		103,069
DENVER, TRW, '74	2	LOADED	7,000	33,529	48,294	29,971		118,794

a/ INCLUDES NO_x ANALYZERS
b/ AUTOMATED
c/ INCLUDES PERSONNEL TRAINING
d/ SAFETY AND EMISSIONS INSPECTION

CHART D

CAPITAL COST ESTIMATES FOR PRIVATE GARAGE SYSTEMS

DATA SOURCE	# OF LDV'S	ADMINISTRATION	EQUIPMENT	BUILDINGS AND LAND	TOTAL
EPA - OTLUP 1/76	1,000,000	$ 25,000	2,200,000 [a]		$ 2,225,000
BATTELLE, TCP 5/75	2,000 (2 LANES)	3,000	17,870		20,870
TEXAS, RADIAN 6/75	3,400,000 (3,382 STATIONS)	391,000	6,764,000		7,155,000
DENVER, TRW, 1974	896,000 (600 STATIONS)	622,000	2,040,000		2,662,000

a/ AVERAGE # LDV'S INSPECTED/STATION/YR = 1,000 (ESTIMATE DERIVED FROM RADIAN AND DENVER STUDIES)
STATIONS NEEDED FOR 1 MILLION LDV'S = 1,000
EQUIPMENT COST/STATION = $2,200

NOTE: ALL STUDIES ASSUME AN IDLE MODE TEST

CHART E

RECURRING COST ESTIMATES FOR PUBLICLY OWNED AND OPERATED SYSTEMS

DATA SOURCE	# LANES	TEST MODE	ADMINISTRATION	INSPECTION	SUPPLIES	OTHER	TOTAL
EPA, OTLUP USED	2	IDLE AND LOADED	$ 33,060	64,000	2,940		$100,000
BATTELLE, TCP 5/75	2	IDLE AND LOADED	33,060	64,000	2,940		100,000
"CONTROL STRATEGIES FOR IN-USE VEHICLES," 5/75	2	IDLE AND LOADED					100,000
OLSON, SCAB VEI STUDY 5/75	2	LOADED	102,600[a]		26,900[c]		129,500
NEW YORK 74	2	LOADED	78,850[b]			"OTHER THAN PERSONNEL" 15,312	94,162
NEW YORK 74[d]	2	LOADED	226,800			"OTHER THAN PERSONNEL" 34,824	261,624
DENVER, TRW '74	52	IDLE	600,000	1,178,000	50,000[c]	ENFORCEMENT: 548,000 DATA COLLECTION: 224,000	2,600,000 83,900/2 LANES
DENVER, TRW '74	68	LOADED	776,000	1,428,000	120,000[c]	ENFORCEMENT: 600,000 DATA COLLECTION: 224,000	3,148,000 92,600/2 LANES

a/ INCLUDES 20% FRINGE
b/ INCLUDES 30% FRINGE
c/ INCLUDES EQUIPMENT MAINTENANCE
d/ EMISSIONS AND SAFETY

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CHART F

RECURRING COST ESTIMATES FOR PRIVATE GARAGE SYSTEMS

DATA SOURCE	# STATIONS	ADMINISTRATION	INSPECTION	ENFORCEMENT	DATA COLLECTION	OTHER	TOTAL
EPA - OTLUP NSED	1,000	50,000[a]	2,000,000	150,000[a]			2,200,000
BATTELLE, TCP 5/75	2 LANES	33,060[a]	64,000			SUPPLIES: 2,940	100,000
RADIAN, TEXAS 6/75	3,382	179,700[a]	1,768,000		398,100	STICKERS: 1,818,900	4,164,700
DENVER, TRW 74	600	180,000[a]	2,800,000	660,000[a]	224,000[a]	OVERHEAD: 558,000	4,422,000

a/ COSTS BORN BY STATE; ALL OTHER COSTS BORN BY PRIVATE GARAGES PARTICIPATING IN THE INSPECTION.

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Technical Notes

1) A large state such as California would require a substantial staff effort. A comparison of contractor versus State annual labor costs for California's change of ownership I/M program indicated figures of $3,243,000 (1979) versus $8,836,665 (1978) respectively (references 9 and 10).

2) New Jersey has determined that nearly $20 million in revenue would be lost if its safety and emissions program were discontinued. By combining safety and emissions testing programs, New Jersey has been able to certify vehicle owner insurance, licensing and auto registration as well (reference 13).

3) See reference 3.

4) See references: 3, pg. 40; and 10.

5) See reference 15, pgs. 3-4.

6) In an alternative I/M systems analysis for Denver, centralized options required a range of only 44-68 lanes involving 41 stations while a private, decentralized option estimated 600 participating inspection sites (reference 6).

7) The information below is included from reference 4, pg. 72:

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7) (continued)

ESTIMATED DURATION AND THROUGHPUT OF INSPECTION PROGRAMS

Locale	Program	Duration,[a] minutes	Throughput,[b] vehicle/minute
New Jersey	Combined safety and idle mode emission inspection	6	1/1.5
Arizona	Loaded mode emission inspection	6	1/3
Arizona	Motor vehicle safety emission diagnostic inspection demonstration project	25-30	1/8
Oregon	Idle mode emission inspection	4-5	1/3
California	Riverside pilot program - loaded mode emission inspection	6-8	1/3
Cincinnati	Combined safety and idle mode emission inspection	4	1/2
Nevada	Private garage idle mode emission inspection w/adjustments	20-25	NA
Massachusetts	Private garage safety inspection program	8-10	NA
Missouri	Private garage safety inspection program	20	NA

[a] Time for inspection only, does not include waiting time.
[b] Potential throughout for inspection test lanes, does not consider influence of downtime and assumes vehicle always waiting for inspection.

NA - Not applicable.

3.1-55

8) Costs for a dynamometer and supportive hardware have been quoted as ranging from $6400 to $10,000. The costs of HC and CO analyzers have generally been shown to range from $2000 to $2500. A NOx analyzer has been estimated at $2800. Costs for supportive automation, instrumentation and data handling range from $2500-$30,000 (references 1; 5, pgs. 206, 215; 4, pg. 94; 20; pg. 51; 6, pg. 3-10).

9) Illustrative Emissions Test Equipment Costs Per Lane

	GCA(77)	OTLUP(76)	DENVER(74)	ARIZONA(77)	CALIFORNIA(72)	COSTS OF CLEAN AIR (76)
A Emission Analyzers (HC, CO, NOx)	2200	6900[1]	-	1750[2]	-	-
B Dynamometers (loaded mode)	10000	7000	8000	6500	6950	6400
C Instrumentation/ Data Handling	25,000	-		30,000	-	26720

1. A and C for idle mode only
2. For HC and CO only

9) For a more detailed discussion of the various I/M test modes see reference 5, pgs. 30-76; reference 21, pgs. 21-23 and See reference (17) A Review of Control Strategies for In-Use Vehicles; Aerospace Corp., ECTD, USEPA; Dec. 1974.

10) For a discussion of the merits and drawbacks of various approaches to I/M testing see reference 5, pgs. 12-29. See also reference (18) Inspection and Maintenance of Light Duty Gasoline-Powered Motor Vehicles: A Guide for Implementation, EPA, Aug. 1974 , pgs. 2-8-2-11; A Review of Control Strategies for In-Use Vehicles, etc.; Degradation Effects on Motor Vehicle Exhaust Emission, Olson Laboratories, 1976 and An Evaluation of Restorative Maintenance on Exhaust Emission of 1975-1976 Model Year In-Use Automobiles, EPA, 1977.

11) See reference 3, pg. 45.

12) While a generalized approach places the throughput rate for loaded mode testing a 29,000 vehicles per lane year and idle mode at 32,000 vehicles per lane per year, the following specific approach can be utilized:

12) continued

Figuring Throughput and Lane Requirements

Throughput:

1. duration of inspection in minutes divided by operating efficiency of lane (probably between 50% and 80%).
2. Adjusted time per test vehicle (from #1 in vehicles/minute) multiplied by 60 minutes/hour, number of hours of facility operations per day.
3. Multiply vehicle tests per day times days of operation to arrive at vehicle tests per year per lane.

Lane Requirements

1. Assess total number of applicable vehicles.
2. Multiply #1 by failure rate.
3. Add #1 to #2 to obtain total inspections.
4. Divide total inspections (#3) by total inspections possible per lane per year to obtain number of lanes required.

13) For a more detailed discussion of station design criteria and requirements see references 4, pgs. 69-85; and 5, pgs. 77-111 and 197-200.
14) See references 4, pgs. 87-101 and; 5, pgs. 197-207.
15) See technical note #8.
16) See references 10, 4, 5. Conversations also with Ron Householder, State of Oregon DEQ and John Elston, State of New Jersey.
17) See reference 9.
18) Ibid.
19) See references 6 and 4.
20) Increased costs to the consumer under a private garage system were pointed out in both the Denver and St. Louis studies. Nevada's present pilot system involving idle mode testing by licensed service stations, garages and auto dealers can vary the motorist's fee from $8.50 to $16.00. Rhode Island, with a private garage-based system, charges only $4.00, however. Total private garage, decentralized labor costs to be factored into the overall determination of the ultimate inspection fee can be calculated as follows:

Mechanics hourly wage	x	emission test time per vehicle	x	number of affected vehicles	=	labor cost component of total program costs to be incurred by vehicle owners
$9-12.50 per hour		10-25 minutes		n(e.g. 1,000,000)		

21) In reference 5, Arizona noted $550 per inspector for idle and $650 for loaded mode (1976); EPA-OTLUP noted $60,000 per million (reference 1) vehicles (1977); Pennsylvania (reference 19) noted approximately $150 for mechanic and $770 for instruction for initial training (1977) and GCA (St. Louis (reference 4) indicated $350 for both idle and loaded mode mechanic training (1977).
22) See reference 3, pgs 46-47.
23) See reference 3, pgs 49-51 and reference 10.

24) Thomas Getz, Rhode Island Department of Health, telephone conversation June 1978.
25) See reference 6, pg. 3-2 and 4, Table 3.
26) See reference 13.
27) See reference 13.
28) See reference 14.
29) I/M demonstration programs have been or are being conducted in Riverside, California; Tampa, Florida; Chicago, Illinois; and Louisville, Kentucky. In Riverside, vehicles were required to undergo inspection but maintenance of failed vehicles was voluntary. In Tampa, Chicago, and Louisville, all participation was voluntary.
30) See references 12, 5 and 22. Conversations with Ron Householder of the Oregon DEQ, determined the cost of a fully-equipped mobile van with trailer, test equipment including analyzers to cost approximately $40,000.
31) See references 21, 10 and 9.
32) See references 3 and reference 4, pg. 43. $5.0 million in Clean Air Act Section 105 funds will likely become available in FY 79 to assist in the development of introductory I/M programs.
33) See reference 3, pg. 49.
34) Waivers or repair ceilings are noted in the legislative analysis.
35) References 10 and 4.
36) Reference 15 and 17.

(11)

Bibliography

1) "Fixed and Operating Costs of A Two-Lane Inspection Station," OTLUP-EPA, April 1976.

2) "Evaluation of Mandatory Vehicle Inspection and Maintenance Programs," California Air Resources Board, (Preliminary Draft), August, 1976.

3) "Inspection/Maintenance Cost Effectiveness and Feasibility of Implementation;" Bentz, Edward, et al., Long Range Planning Group, OPE: USEPA; May 1977.

4) Viable Alternative Types of Inspection/Maintenance Programs for St. Louis, Final Report, Kincannon,Benjamin, et al., June, 1977.

5) Motor Vehicle Emissions Inspection Program-Technical Report, Volume 5; Arizona Department of Health, Division of Air Pollution Control, Environmental Health Services; Jan. 1974.

6) "Inspection/Maintenance of Light Duty Vehicles in the Denver Air Quality Control Region," TRW, Inc; (Technical Report; Nov. 1974.)

7) "Tune Up for Less Emissions - It's Working," Arizona Vehicular Emissions Inspection Program Operations - 1977, Arizona Dept. of Health Services, Bureau of Vehicular Emissions Inspection, April, 1978.

8) "Evaluation of the Nevada Inspection/Maintenance Programs," (Final Report), GCA Corp./GCA Technology Division, Aug. 1976.

9) "Comparison of Contractor Versus State Operated Vehicle Emissions Inspection Program on Change of Ownership Only" - memorandum from California Bureau of Automotive Repair to California Air Resources Board; May 23, 1977.

10) "California Vehicle Inspection Program - Volume II - Cost Proposal," Hamilton Test Systems, March 1977.

11) "Inspection and Maintenance - Program Elements and Approaches;" USEPA - Region I; updated (1977).

12) "Vehicle Inspection Program; Overview," State of Oregon Department of Environmental Quality, 1978.

13) "Motor Vehicle Inspection System Study Commission; Final Report 1978," State of New Jersey Motor Vehicle Inspection Study Commission, May, 1978.

14) "Inspection and Maintenance in the Nevada Context," F. H. Castaline, GCA Corp., GCA Technology Division, paper presented to Fifth Annual NorthAmerican MVEC Conference; Oct. 26, 1976.

15) "Inspection/Maintenance Policy Paper," U.S. Environmental Protection Agency, July 17, 1978.

16) Memorandum from R. D. Gafford (Olson Laboratories) to F. B. Cronin (EPA-OAWM); dated June 18, 1974.

17) A Review of Control Strategies for In-Use Vehicles, Regospace Corp. and EPA-ECTD; Dec. 1974.

18) Inspection and Maintenance of Light-Duty, Gasoline-Powered Motor Vehicles: A Guide for Implementation, U.S. EPA-SASD; Aug. 1974,

19) Memorandum from G. L. Triplett, (Pa. BAQNC) to G. R. Bonina, EPA Region III; Nov. 5, 1976.

20) Draft of "Costs of the Clean Air Act," 1976, p. 72.

21) Information Document on Automobile Emissions Inspection and Maintenance Programs, EPA 400/2-78-001, 1978.

22) "Vehicle Emissions Testing Systems - Cost Analysis for City of Chicago" Olson Laboratories, Feb. 1973.

23) "Periodic Motor Vehicle Inspection," Highway Safety Program Manual No. 1, Jan. 1974, U.S. DOT, NHTSA.

24 "Motor Vehicle Inspection/Maintenance in the U.S. An Update;" - Bruce Carhart, USEPA, paper delivered to the 6th Annual Meeting MVECC; April 5, 1976.

Suggested Content for Inspection/Maintenance Legislation

USEPA's policy for what constitutes an acceptable I/M program is outlined in Section 1.2. However, enabling legislation for I/M can be in many different forms. This paper provides a brief overview of general subjects which can be contained in I/M legislation. No attempt is made here in this section to specify what is desirable for state legislation in general. Many parts of this section indicate that certain elements may be included in legislation. In most cases such elements can just as easily be addressed by the administering agency in the form of technical and procedural rules and regulations. These subjects are indicated by * in the sentence or phrase where they appear. A tabular representation detailing the content of eight state inspection/maintenance (I/M) statutes plus the I/M ordinance of the City of Chicago is provided in Section 4.2. While this table should provide some assistance in determining appropriate legislation, local factors should of course be considered and Section 1.2 should be consulted.

Guidelines for Model Legislation Components

1. Definitions

May include procedural and organizational terms used in a specific or unusual sense, as well as all technical terms.

2. Purpose

Indicates the intent and general context of the program, and defines the agency responsible for its execution. (May identify two agencies for responsibilities such as state air agency and state department of motor vehicles).

3. Type of Program

Establishes the form in which inspection will take place. May specify requirements for state facilities and provide for their acquisition, construction or modification. May alternatively provide for contracting to private firms for administering centralized inspections. May provide for facilities (e.g., repair garages). May outline bidding processes, terms of contracts, qualification of contractors, etc.

4. Procedures

May define mode of testing to be employed.* May associate emissions test with safety test procedures, specify vehicle components to be examined, emissions of concern, equipment to be used and procedures to be followed.*

5. Staff

Provides for staff and their training to operate state-run facilities, or to inspect and maintain terms and standards of contracted or certified inspection stations.

6. Implementation Schedule

Establishes major milestones of program. May provide for voluntary phase-in period, public information campaign, scheduling of inspections themselves (e.g., monthly staggering, and dates upon which various levels of enforcement will take effect). May also make special provisions for fleet inspections.*

7. Standards for Emissions

May define pass/fail criteria and/or stringency factors to be observed,* including the allowable levels of various gaseous emissions (may be stratified according to model types and/or years). May also require the presence and proper operation of vehicle emission control systems.

* Can also be done by regulations promulgated by administering state agency.

8. Requirements for Vehicle Registration

Provides for the distribution of certificates, stickers, etc. as validation of compliance with inspection standards. May require such certificates as prerequisite to annual vehicle registration or transfer of ownership. May require such certification within a specified time period before sale by used vehicle dealerships.* May set guidelines for retesting of failed vehicles after repair, or of passed vehicles after accidents requiring repair. May disallow falsification or improper granting of such certificate.

9. Enforcement

Prescribes penalties for non-compliance with other provisions of legislation. May prohibit operation of uncertified or non-compliant vehicles. May define function of state inspectors to maintain standards of contracted private inspection operations. May allow for spot-check retesting of certified vehicles by enforcement authorities. May set time limits for compliance with repair or certification requirements.

May provide for:

(1) suspension of registration (in which case vehicles are prohibited from using the highway) for vehicle owners who cannot demonstrate their vehicles passed the applicable test standards.
(2) revocation of station inspection permit for licensed private garages in decentralized systems for failure to follow applicable rules and regulations.
(3) fines and/or imprisonment for noncompliance with applicable rules and regulations.

* Can also be done by regulations promulgated by administering agency.

10. Applicability and Exemptions

Indicates classes of vehicles to which program requirements apply and do not apply, e.g., light-duty vehicles, light-duty trucks, etc. May specify weight limitations.* May exempt heavy duty, non road-use, and historic or rare vehicles, motorcycles, motor-driven bicycles, golf carts, etc.*

11. Public Information

Provides for the compilation and distribution of consumer information such as standards and regulations, inspection procedures and scheduling, likely repair problems and costs, the seriousness of the air pollution situation, etc.

12. Repairs

Specifies guidelines* for repair and adjustment procedures pursuant to failed inspections. May regulate charges for specific repairs.* May provide for special training and certification of repair personnel,* and specify uniform instrumentation and its use for repair stations.* May set terms of authorization of repair stations* and regulate the re-testing and certification of failed vehicles after repairs.

* Can also be done by regulations promulgated by administering agency.

13. Records and Review

Provides for the collection and storage of records on vehicles inspected, inspection results and repairs performed. Provides for the ongoing analysis of the effectiveness of the inspection, certification and repair procedures, and the assembly of such records and analyses into regular reports. May also provide for the review and updating of the program on the basis of such reports.

14. Financing

Provides for the funding of the program on the basis of a specified combination of intergovernmental grants, revenues, and inspection fees. May establish maximum fees, and proportions of operating or capital costs to be covered by each source. May allocate specific dollar amounts for initial funding. May create an "Emission Inspection Fund" for the fees which will subsequently be used to support the program.

15. Severance Clause

Allows for the severance of any part of the statute due to its unconstitutionality or invalidity.

* Can also be done by regulations promulgated by administering agency.

ANALYSIS OF STATE STATUTES

Attached is a table which reviews the content of I/M legislation from the States of Arizona, California, Colorado, Connecticut, Nevada, New Jersey, Oregon, and Rhode Island, and the I/M ordinance from the City of Chicago. A "+" in the table indicates inclusion in the bills that established the individual I/M programs. However, such inclusions are not all-encompassing. For instance, "technical rules and regulations" frequently means only that the law authorizes the administering agencies to adopt necessary rules and regulations to implement the program. For details of a particular State's I/M authority, the reader should refer to the full text of the appropriate I/M law.

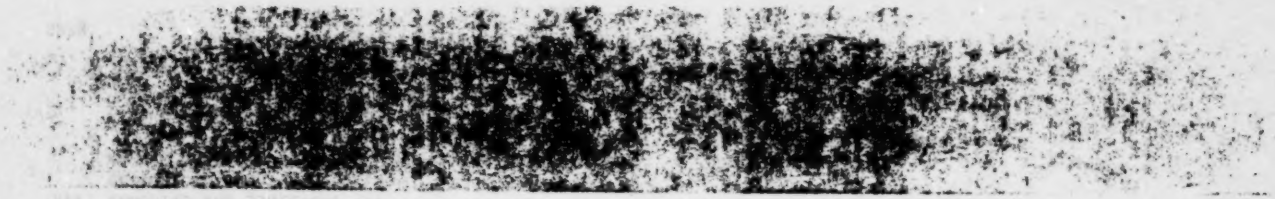
ANALYSIS OF STATE STATUTES REGARDING MOTOR VEHICLE EMISSION REGULATIONS AND PROVISIONS

	ARIZONA	CALIFORNIA	CONNECTICUT	CHICAGO	COLORADO	NEVADA	NEW JERSEY	OREGON	RHODE ISLAND
I. Department Authorized to Administer The Emission Control Program	Dept. of Health Services	Dept. of Consumer Affairs State Air Resources Board Cal. Highway Patrol	Department of Environmental Protection Department of Motor Vehicles	Dept. of Environmental Control	Dept. of Health (air pollution control division) Dept. of Revenue Air Pollution Control Commission	State Environmental Control Dept. of Motor Vehicles Dept. of Human Resources	Dept. of Environmental Protection Dept. of Motor Vehicles	Environmental Commission	Registry of Motor Vehicles (Department of Transportation)
II. Authority to Hire Outside Contractors for Program Operation									
Independent Contractor (bidding requirement and prohibition against having financial interest in repair facilities)	Dir. of Health Services authorized to enter into an agreement w/one or more contractors +	Dept. of Consumer Affairs Authorized to Contract w/private or public entities + (California)	+ (Connecticut)						

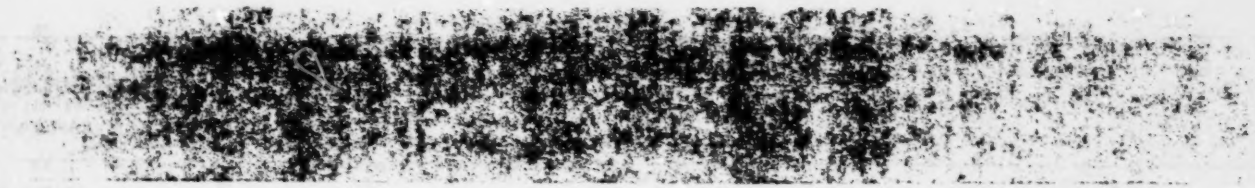
9/78

	ARIZONA	CALIFORNIA	CONNECTICUT	CHICAGO	COLORADO	NEVADA	NEW JERSEY	RHODE ISLAND	OREGON
III. Requirements for Vehicle Inspectors									
Examination or demonstration of skills, competence, and capability		+ (by way of contract)	+		+	+	+	+	+
IV. Technical Standards and Regulations	+	+	+	+	+	+	+	+	+
(rules pertaining to the operation and maintenance of emission inspection stations; licensing emission inspectors and standards of approval, operation, calibration, and certification of exhaust gas analyzers)									
V. Requirements for Vehicle Registration	+	+	+	+	+	+	+	+	+
(inspection test and evidence of compliance)									
VI. Exemptions	+	+	+		+	+	+	+	+
A. New Motor Vehicles	+	+	+		+		(no inspection until vehicle is 2 years or older)		+
B. Transfer (private-public)sale vehicles	+				+				
C. Model and year of vehicle	+ (cars 15 years old)		+ (cars manufactured prior to 1968)		+ (cars manufactured prior 1977)				+ (cars manufactured prior to 1942)

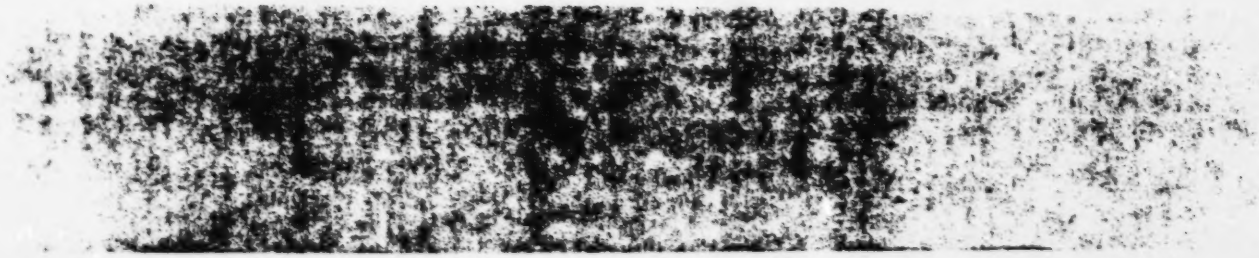
	ARIZONA	CALIFORNIA	CONNECTICUT	CHICAGO	COLORADO	NEVADA	NEW JERSEY	OREGON	RHODE ISLAND
VII. Required Inspection Frequency	+	+	+	+	+	+	+	+	+
Annual	+	No (change-of-ownership)	+	+	+	+	+	No (biannual inspection)	+
Note: each state provides for a maximum time period for inspection prior to registration									
VIII. Public Information		+				+			
A. Consumer Education Provision		+				+			
B. Information Allocation		+				+			
IX. Fee Structure	+	+	+		+	+		+	+
A. Maximum allowable charge per inspection	+ (charge not to exceed $5.00)		+ (charge not to exceed $5.00)		+ (charge not to exceed $5.20)	+ (charge based on prevailing shop labor rates)			



	ARIZONA	CALIFORNIA	CONNECTICUT	CHICAGO	COLORADO	NEVADA	NEW JERSEY	OREGON	RHODE ISLAND
Fee Structure (cont.)									
B. Fee to be fixed and adjusted by an authorized official to reflect both the contractual charge (where applicable) and any escalation or decrease of administration costs.	+	(fee charged must be sufficient to "match" any federal grants awarded)	+						
NOTE: All fees collected at the time of registration are deposited in the state's Inspection Fund.		(fee also must cover reimbursements to Motor Vehicle Account in the Transportation Tax Fund)							
X. Reinspection for Certification without an Additional Charge	+		+	+	+	+		(allows for reinspection w/in 30 days)	+
NOTE: All states which provided for reinspection w/out additional charge, also required that reinspection occur w/in a specified time limit.									
XI. Referee or challenge lane facility to insure protection of vehicle owners			+ (allowed, but not specifically mentioned)		+				+ (legislative authority to provide for "referee" facility)



	ARIZONA	CALIFORNIA	CONNECTICUT	CHICAGO	COLORADO	NEVADA	NEW JERSEY	OREGON	RHODE ISLAND
XII. Maximum allowable charge to vehicle owners to bring vehicles into compliance	+ (not to exceed $25.00 for pre-1968 vehicles and $75.00 for 1968 and later vehicles)	+ ($50.00 w/a provision to raise to $75.00 necessary) (escalation of repair charge reflects the consumer price index)	+ (not to exceed $70.00)			+ (no fee specified; however, the State Environmental Commission shall set repair cost limits in a manner to avoid unnecessary financial hardship)			
XIII. Monitoring Provisions to insure compliance by vehicle inspectors	+	+	+		+	+	+	+	+
Provision for the submission of all emission inspection records and documents pertaining to the operation and maintenance of the emission/inspection station	+	+ (by way of contract)	+		+	+	+		+
XIV. Remedies and Sanctions for failure to comply with standards, rules or any other provisions (Fines, imprisonment, prohibition against operating noncomplying vehicles on the highway, etc.)	+	+	+	+	+	+	+	+	+



	ARIZONA	CALIFORNIA	CONNECTICUT	CHICAGO	COLORADO	NEVADA	NEW JERSEY	OREGON	RHODE ISLAND
Remedies and Sanctions (cont.) NOTE: Suspension of registration is in addition to a fine and/or imprisionment in all cases.									
XV...Emission Inspection Fund	+	+	+		+	+		+	
XVI. Severance Clause			+						+

(136) 136X

Public Information and the Establishment of Inspection/Maintenance Programs

Who Should Get Involved?

Since almost everyone contributes to air pollution from motor vehicles, almost everyone should get involved in a program to deal with it. Through an I/M program every registered car owner with only minimal inconvenience can make an individual contribution to improved air quality.

The first step in getting such a program underway in your State is enabling legislation. Such legislation will be enacted only if citizens work actively for its passage. Citizens need to know and understand the seriousness of the problems and its health effects, what an I/M program can do, what benefits they can expect, how much it will cost, and how a program works. Developing I/M public awareness will take a continuing information program during the months ahead. To get an I/M program in place, a State and/or organizations must develop and plan activities to ensure a continuing flow of information. Groups who have a role or interest in I/M legislation and should potentially be involved, include (but are not limited to) the following:

State, local government

air pollution control agencies
motor vehicle agencies
state legislators/staff
energy and transportation officials
elected officials/staffs

Public Interest Groups

League of Women Voters
American Lung Association
consumer protection groups
Sierra Club
clean air coalitions/environmental groups
League of Cities
Conference of Mayors
National Association of Counties

Civic Groups

Chamber of Commerce
Jaycees
Kiwanis
Urban League
NAACP

Health Groups

State, County Medical Societies
Public Health Association

Auto Related Services

automotive service organizations
dealers associations
garages and service stations associations
auto parts manufacturers and suppliers
emission analyzer manufacturers
gasoline retailers

Organized Auto Owners

auto clubs
sports, recreational groups

Media

newspaper
trade press
special press
radio stations
television stations

How to Enlist Help

A core group involved in I/M already exist. American Lung Association

chapters across the country are supporting I/M to further reduce air pollution and its related lung problems. The ALA and EPA joined forces to develop a multi-media package of informational materials on I/M (see pages) which can be useful in encouraging broader understanding of the program.

Other programs such as the ones listed above can easily get involved, too.

What can Groups do?

* Obtain information for members and then contact other potentially interested groups.

* Arrange workshops, seminars, and public meetings to brief citizens and other organizations on the air quality status in individual areas and the requirements that must be met under the Clean Air Act. Emphasize I/M. Invite appropriate media. Solicit help in reaching other groups.

* Where meetings cannot be arranged or are infeasible, write to various groups, include brief information and offer additional help. Follow up by telephone to see what additional information might be needed.

* Contact your district legislators and brief them on the need for an I/M program.

* Encourage others to write or contact their legislators.

* Meet with appropriate legislative committees and present views.

* Attend public meetings where I/M or air quality is being discussed and present views.

* With other community groups, sponsor a town meeting, invite legislators, State and local officials to discuss air quality problems and I/M as one possible solution.

* Develop a leaflet explaining I/M and encourage other groups, gas stations and garages to distribute.

* Include an I/M article in your regular publication or newsletter.

* Borrow a copy of the ALA/EPA film, "On the Road to Clean Air" and show it to various additional groups.

* Coordinate with a local emission analyzer manufacturer to set up a demonstration testing station in a shopping mall or urban center to give people an opportunity to have their car inspected for emissions levels.

* Work with a health organization to develop an exhibit on the health effects of air pollution for display at a county or State fair or another well-attended event.

* Sponsor a poster or bumper sticker contest for school children on the need for I/M programs, have various groups offer prizes and plan to exhibit in area accessible to the public.

How to Make Effective Use of Media

The media--newspapers, radio and television--can alert and inform large number of citizens to the need for, the benefits of, the costs and the kinds of I/M programs that can be considered.

How to Get Press Coverage

* Invite environmental reporters and news editors to an I/M briefing, show them the film "On the Road to Clean Air", provide them with additional information and contact people who can answer questions.

* Invite press to a voluntary demonstration that is being held in the vicinity.

* Provide information on the status of enabling legislation for I/M programs.

* Help to arrange interviews with key state and/or local government officials involved in I/M considerations.

* Provide information on successful programs in other cities and States.

* Provide information and background on the local situation to editorial writers.

* Invite reporters to public meetings and hearings.

* Develop press releases on significant activities your organization has planned on I/M.

* Encourage local newspapers to feature a question box where readers can write in questions and expect an answer.

How to Interest Radio and Television

The broadcast media provides many opportunities to reach broad segments of the public and stimulate public discussion and involvement in I/M programs. In addition to their news and editorial coverage commercial and public radio and television stations are required by the FCC to determine community needs and make their programming responsible to these needs through public service spots and programs.

To tap public service time, organizations might:

* Suggest a panel discussion of air quality problems and the role of I/M in reducing the problem.

* Offer the EPA film "On the Road to Clean Air" for viewing.

* Suggest a call-in show for viewers and listeners at home to ask I/M and air quality questions of a knowledgeable person.

* Encourage a documentary or feature on the local air pollution situation and on the role of I/M as one solution in minimizing pollution.

* Suggest a panel discussion on the health effects of air pollution and the status of air quality improvement in your city.

Other Opportunities

The trade and special press-professional and technical journals or newspapers, environmental and other newsletters, and church or civic publications offer many opportunities to get I/M information to citizens. Contact the editor and provide him or her with additional information.

Available Materials

I/M information materials which are available include:

Film

"On the Road to Clean Air"--a 17-minute color film covers purpose and need for I/M programs, the benefits and costs and how a program operates. Available from your local ALA chapter or from EPA Regional Offices on a free-loan basis.

Publications

"Information Document on Automobile Emissions Inspection and Maintenance Programs" - EPA-400/2-78-001 (February 1978) a report produced pursuant to Section 108 of the Clean Air Act which presents substantial information on all aspects of inspection/maintenance programs. Available from EPA.

"Turning Down Auto Air Pollution"--a 16-page booklet which discusses the need for I/M programs, the benefits and costs and how a program works. Available from EPA.

"Get a Check-up for your Car"--a leaflet on the need for keeping cars well maintained to cut pollution along with pointers on what can go wrong with your engine and what to do about it. Available in English and Spanish from your local ALA chapter or EPA regional office.

"Do You Own a Car"--a leaflet which explains pollution control systems and gives the reasons why motorists should not tamper with those devices. Available from EPA.

"The Health Effects of Air Pollution"--a 16-page pamphlet which discussess the various air pollutants and the effects they have on health. Available from EPA.

Materials for the Mass Media

American Lung Association (ALA) TV spot - a 60-second television

presentation which emphasizes the need for regular car maintenance to minimize auto-related air pollution. Produced in cooperation with the ALA and Car Care Council. Available from ALA and EPA.

ALA radio spots - four 30-second presentations, including one in Spanish, which stress the connection between air pollution and the automobile. Available from ALA and EPA.

(EPA 140)

Materials Developed at the
Center for Motor Vehicle Emissions Control and Safety

Available Through the Department of Industrial Sciences,
Colorado State University, Fort Collins, Colorado 80523

	Reference Number	Cost
Motor Vehicle Emissions Control Instructional Materials Packet	1122-0	$145.00

Designed as a complete multimedia training course which includes: Technical related narrative, 35mm slides and audio cassette tapes, test questions with answers and laboratory exercises with tool list. This instructional packet is designed for vocational automotive teachers who wish to train future mechanics, mechanics in the field and additional teachers on the basic concepts of emissions and vehicle emissions control systems.

Instructor's Guide for use with Vehicle Emissions Control Instructional Materials Packet	0331-3	6.50

Designed to aid the instructor in class preparation, demonstrations, "hands on" sessions and the presentation of the "Colorado Emissions Control Packet" (0331-1) and/or the "Motor Vehicle Emissions Control Packet" (1122-0). It consists of key points for improving classroom presentation, suggestions for dramatic "table top" and "live vehicle" demonstrations as well as class formation, time budgeting and effective use of components for demonstration purposes.

Emissions Control Multi-Media Kit	1122-1	150.00

Designed as a complete multi-media auto mechanics training course. This Kit includes 359 slides (35 mm); 8 audio cassettes; test questions with answer key and laboratory exercises (including tool list) plus a complete easy to follow instructor's guide. This kit has been designed primarily to be used in the teacher training workshops but is available as an excellent instructional aid for teachers with some background in emissions control instruction. The kit includes 1122-0 and 0331-3.

Chemistry of the Internal Combustion Engine - Running Time (41 min.)	1122-2	50.00

A 3/4 inch color video presentation on fuel composition and changes resulting from the combustion process.

	Reference Number	Cost
Motor Vehicle Emissions Control - Series of Seven Books	1159-1	$ 10.00

A series of seven illustrated self-instructional books (391 total pages) designed to teach the concepts of emissions control systems. The seven topics covered are: Positive Crankcase Ventilation Systems; Thermostatic Air Cleaner Systems; Air Injection Reaction Systems; Fuel Evaporation Control Systems; Exhaust Gas Recirculation Systems; Spark Control Systems; and Catalytic Converter Systems. Allow one kit for each student since it is a consumable workbook.

Emissions Control Training Mechanics Handouts	1167-1	1.75

Designed to be used in conjunction with the "Motor Vehicle Emissions Control Instructional Materials Packet" (1122-0). The booklet contains handouts, laboratory exercise worksheets and other related information. It is intended for mechanic use while attending an instructor facilitated workshop.

It is not designed for use alone, or as a self-instructional device or textbook.

A Primer On Auto Emissions Systems for Home Mechanics	1167-2	3.50

A book designed to acquaint the vehicle owner who likes to maintain his automobile with the basic emissions control systems and components installed on today's cars. It contains animated, easy to understand, step by step procedures for checking various components related to emissions control systems. This book is not intended to be a substitute for, or replace a good emissions control service manual.

Instructor's Guide for Vehicle Emissions Control Training	1167-3	4.50

A self-contained curriculum with narrative, illustrations and overhead transparency masters. It is designed for instructors with limited background and equipment, who want to teach the basic concepts and key points of vehicle emissions control systems.

This guide is part of a training package consisting of "Instructor's Guide" (1167-3) "transparency Masters" (1167-4) and "Student Workbook" (1167-5) designed to be used together.

Transparency Masters for use with Instructor's Guide for Vehicle Emissions Control	1167-4	3.00

This training aid provides all the transparency masters which are identified in the Instructor's Guide.

	Reference Number	Cost
Student's Workbook for Vehicle Emissions Control Training	1167-5	$ 3.00

A workbook designed to lead students through key points of vehicle emissions control concepts. This workbook parallels the presentation given in the "Instructor's Guide" (1167-3) and requires the student's participation by responding to questions and key points and by performing simplified "hands on" exercises.

Teacher Classroom Kit	1167-9	10.00

A self-contained curriculum complete with all materials and instructions necessary for instructors with limited background and equipment to teach the basic concepts and key points of vehicle emissions control systems. The kit includes 102 page instructor's guide, 116 transparency masters and 1 copy of the student workbook (99 pages). All teaching aids employ a low verbal-pictorial approach. The kit includes 1167-3, 1167-4 and 1167-5.

Electronic Ignition Systems	1167-6	35.00

An introductory level approach to electronic ignition theory and operation with comparisons to conventional systems. It is designed to be incorporated into the "Motor Vehicle Emissions Control Instructional Materials Packet" (1122-0).

The media used is an audio cassette tape, slides, narrative, test questions and answers.

Colorado Vehicle Emissions Control Mechanic Workbook	0331-2	1.75

Designed to be used by the student in conjunction with the "Colorado Emissions Control Packet" (0331-1) and/or the "Motor Vehicle Emissions Control Instructional Materials Packet" (1122-0). Each segment of this student workbook contains emissions concepts, laboratory exercises, self-check questions and related information. It is not designed for use alone, or as a self-instructional device or textbook.

Introduction for Vehicle Emissions Control	0331-4	150.00

Two 3/4 inch color video cassettes of an animated introduction to emissions control systems. There are eight (8) presentations with an approximate running time of 10 minutes each. The tapes were produced from the booklet, A Primer On Auto Emissions Systems for Home Mechanics.

	Reference Number	Cost
Colorado Vehicle Emissions Control Idle Test Book	0331-5	$ 1.00

A detailed presentation to be used in the Colorado Idle Inspection/Maintenance program. It includes the use of the infrared analyzer and inspection procedures. In addition, a section covers probable causes of excessive emissions that would result in a vehicle failing the idle inspection.

I/M Program Implementation Milestone Schedule

This planning schedule is presented in three large phases: 1. program planning, 2. preparation for the introductory phase, and 3. implementation of the introductory phase and preparation for the fully mandatory phase. The timing of the elements indicated may differ from state to state. The options for implementation included within the schedule are:

Option A - Decentralized stations (licensed private garages);

Option B - Centralized stations, state-owned and operated; and

Option C - Centralized stations, contractor-owned and operated.

Program Planning Phase

From Month-12 to Month +2*

This phase should be begun before legislation is enacted.

From Month -12 to Month -6:

1. Prepare analysis of benefits and costs of program.
2. Initiate public information effort including
   a. the public
   b. affected interest groups
   c. public officials
3. Prepare legislative proposal.
4. Develop schedule for I/M implementation.

From Month -6 to Month +2:

1. Continue public information program.
2. Finalize system format
   a. Program type
      1. decentralized
      2. state-run centralized
      3. contractor-run centralized
   b. Type of inspection test
   c. Type of enforcement
   d. Recordkeeping and reporting

* Month 0 = legislation enacted.

e. Consumer protection features e.g.

1. Upper limit on cost of repairs

2. "Challenge" or "referee" station

3. Mechanics training

4. System for processing consumer complaints

f. Enforcement system including provisions for:

1. Vehicle owner compliance

2. Licensed inspection station compliance (if applicable)

g. Fee collection system

3. Consideration of necessary standards and regulations.

Preparation for Introductory Phase

The three main possibilities for an introductory I/M phase are:

1. mandatory inspection with voluntary maintenance;
2. change-of-ownership mandatory inspection and maintenance; and
3. voluntary inspection and maintenance.

Each of these possibilities can be in each of the three implementation options.

A. Decentralized Option

(From Month 0 to Month 6)

1. Notify garages explaining program and schedule for implementation

2. Adopt standards and regulations including emission analyzer requirements and licensing requirements for private garages

3. Notify and explain to garages actions in step 2.

4. Train inspectors and license garages

5. Prepare "referee" station(s).

B. State-Run Centralized Option

(From Month 0 to Month 18)

1. Design stations.

2. Develop and issue any RFPs necessary.

3. Award any necessary contracts.

4. Acquire land.

5. Build inspection facilities.

6. Hire and train inspectors.

7. Adopt standards and regulations including emission analyzer requirements.

8. Acquire equipment.

C. Contractor-Run Centralized Option

(From Month 0 to Month 18)

All of the steps in Option B are needed in this option as well, except 1,4,5,6, and 8 are done by a private contractor.

Other Necessary Elements for Introductory Phase

All three options need the following addditional elements.

1. Continue public information program with new emphasis to public on the reason for the I/M program and the coming I/M requirements.

2. Hire administrative personnel.

3. Develop and adopt either preliminary or final cutpoints. (Introductory phase may be used to develop cutpoints.)

4. Finalize record reporting system.

5. Finalize fee collection system.

6. Finalize enforcement system (if inspection is mandatory in introductory phase or if change-of-ownership phase is planned).

Implementation of Introductory

Phase and Preparation for Fully Mandatory Phase

Decentralized - From Month 6 to Month 18

Centralized (State-Run or Contractor-Run) - From Month 18 to Month 30

1. Initiate testing.

2. Continue public information program, stressing the reason for the I/M program plus the locations and hours of the stations.

3. Institute calibration, monitoring, and enforcement* procedures, including auditing program if system has licensed private stations.

4. Institute record reporting system.

5. Institute plan for consumer protection.

6. Evaluate emission data in introductory phase and finalize cutpoints if not already finished.

7. Train mechanics (and inform do-it-yourselfers) or institute a program of public information of service establishment with approved emission analyzers.

* not for voluntary inspection and maintenance

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